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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN 190.

A. C. TRUE, Director.

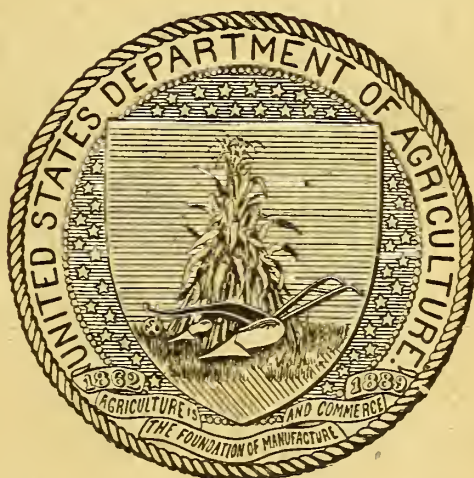
IRRIGATION IN NORTHERN ITALY.

Part II.

BY

ELWOOD MEAD,

Chief of Irrigation Investigations.



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1907.

LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON IRRIGATION AND DRAINAGE.

NOTE.—Publications marked with an asterisk (*) are not available for distribution.

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- *Bul. 104. The Use of Water in Irrigation. Report of investigations made in 1900, under the supervision of Elwood Mead, expert in charge, and C. T. Johnston, assistant. Pp. 334. (Separates only.)
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- *Bul. 119. Report of Irrigation Investigations for 1901, under the direction of Elwood Mead, chief. Pp. 401. (Separates only.)
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[Continued on third page of cover.]

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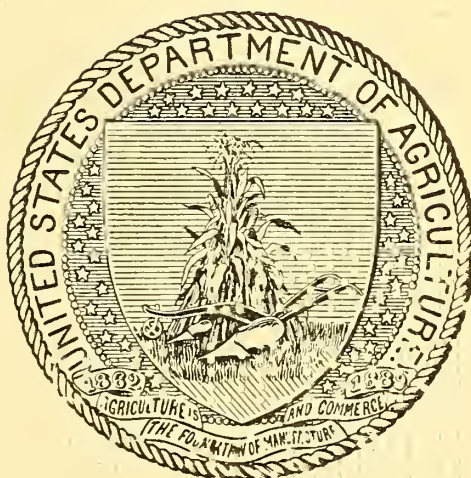
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(2)

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 1, 1907.

SIR: I have the honor to transmit herewith Part II of a report on Irrigation in Northern Italy, by Dr. Elwood Mead, chief of Irrigation and Drainage Investigations of this Office, who visited that country in the summer of 1903. Part I of this report (Bulletin No. 144 of this Office) contains descriptions of irrigation works in Piedmont and Lombardy and discussions of their operation. Part II deals with the section watered by the Adda and Adige rivers, and takes up especially the legal and institutional phases of irrigation, describing the operation of canals controlled by the Government and those controlled by cooperative associations of water users.

The history and present status of the irrigation laws of Italy is given with some comparisons with American conditions.

It is recommended that this report be published as a bulletin of this Office.

The illustrations, consisting of four plates and two text figures, are necessary for a proper understanding of the text.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

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IRRIGATION IN NORTHERN ITALY—PART II.

INTRODUCTION.

Part I of a report on irrigation in northern Italy has been published as Office of Experiment Stations Bulletin No. 144. It dealt with observations made in the summer of 1903 in Piedmont and Lombardy between the cities of Turin and Milan. In this bulletin the report of that investigation is continued, but the plan outlined in the first report has been somewhat modified. Instead of attempting to describe all of the districts visited, a selection has been made of a few irrigation systems whose history or management has lessons of practical value in the working out of the irrigation problems of this country. These canal systems have been selected because they show in part the evolution of the present irrigation system of Italy. They furnish illustrations of the working out of many problems closely resembling those which have arisen in the evolution of our own system, and the conditions of the two countries are near enough alike to make the actual results there reasonable or probable here. In these studies little attention has been given to the engineering features of irrigation, although the canals seem to furnish many fine illustrations of headworks, drops, flumes, and measuring devices. There is nothing new or novel in these, however. Equally good structures are to be seen on all modern canals in this country and their description would not advance engineering practice. Moreover, this investigation deals particularly with the agricultural and economic features of irrigation. Canal management is the weak feature of irrigation in America: irrigators do not get the water they buy; men who keep up canals have no voice in their operation; and the man with a just grievance has no way of securing relief and the chronic objector has many chances to become a nuisance. The careful thoroughness of the administration of the Ritorto Canal has practical lessons for many irrigation districts. On the other hand, there are not lacking examples of "graft" and favoritism. The fact that the Muzza, a State canal, does not pay running expenses shows that State aid is not always a financial success. In addition, the evolution of these canal systems illustrates the practical workings of the Italian irrigation code.

Four of the canals described in this report take water from the Adda River; the fifth is supplied from the Adige. The Adda rises on the southern slopes of the Alps, flows through Lake Como, which serves as a natural regulator, and after traversing the foothills south of the lake for several miles, reaches the north boundary of the Po Valley, which it crosses in a southeasterly direction, and empties into the Po near Cremona. The location of the canals studied and the territory irrigated from the Adda are shown on the map. (Pl. I.)

The first of the canals to be studied was the Martesana. It was inspected in company with Mr. Grossi, the assistant engineer. Its headgate is the highest of all irrigation systems from the Adda, the only diversions above that point being for power purposes. The appearance of the valley at the head of the Martesana is shown in Plate II, figure 1. It is a most picturesque region, but one ill-suited to canal building, as the bluffs bordering the river are high, rocky, and steep. The river at this point has a rapid fall. Its surface is capped with foam as it plunges down over the immense boulders which obstruct the channel. Naturally picturesque, the beauty of the scenery of this region has been greatly enhanced by its historic interest. Many of the bluffs are crowned with the ruins of medieval castles or with beautifully kept terraced gardens surrounding palaces and villas, which furnish illustrations of the best work in modern architecture and landscape gardening.

At the foot of one of the piers of the bridge shown in Plate II, figure 2, is the official gauge rod established by the Government as a basis for determining how the water shall be divided among the canals below, there being no diversions above this point except one for power. On August 19 the river carried 10,600 cubic feet per second, making it rank at this time of the year with the Snake and Yellowstone among rivers used in irrigation in this country. Its flood flow is not so large as these streams, the high-water record being 29,190 cubic feet per second, but the low-water flow, 1,300 cubic feet per second, compares favorably with our larger western streams.

Many things combine to make this an interesting river on which to study irrigation institutions. The history of its water rights goes back to the golden days of the Venetian Republic, when that enterprising government established colonies and built canals to grow flax for its eastern trade. The river was the boundary line between the Venetian Republic and the shifting governments of Lombardy, and water rights on the east bank were governed by the policies of one government, water rights on the west bank by the policies of a different government. Conflicts between priorities on the east and west banks had to be settled by international tribunals up to the time when the union of Italy brought the conflicting rights and incongruous policies under a single government.

MAP OF FOUR PRINCIPAL CANALS DIVERTING THE ADDA RIVER WITH THE LANDS IRRIGATED

- LEGEND
- Canals
 - Ditches
 - Railways
 - Boundary Line between Irrigated Areas by different Canal Systems

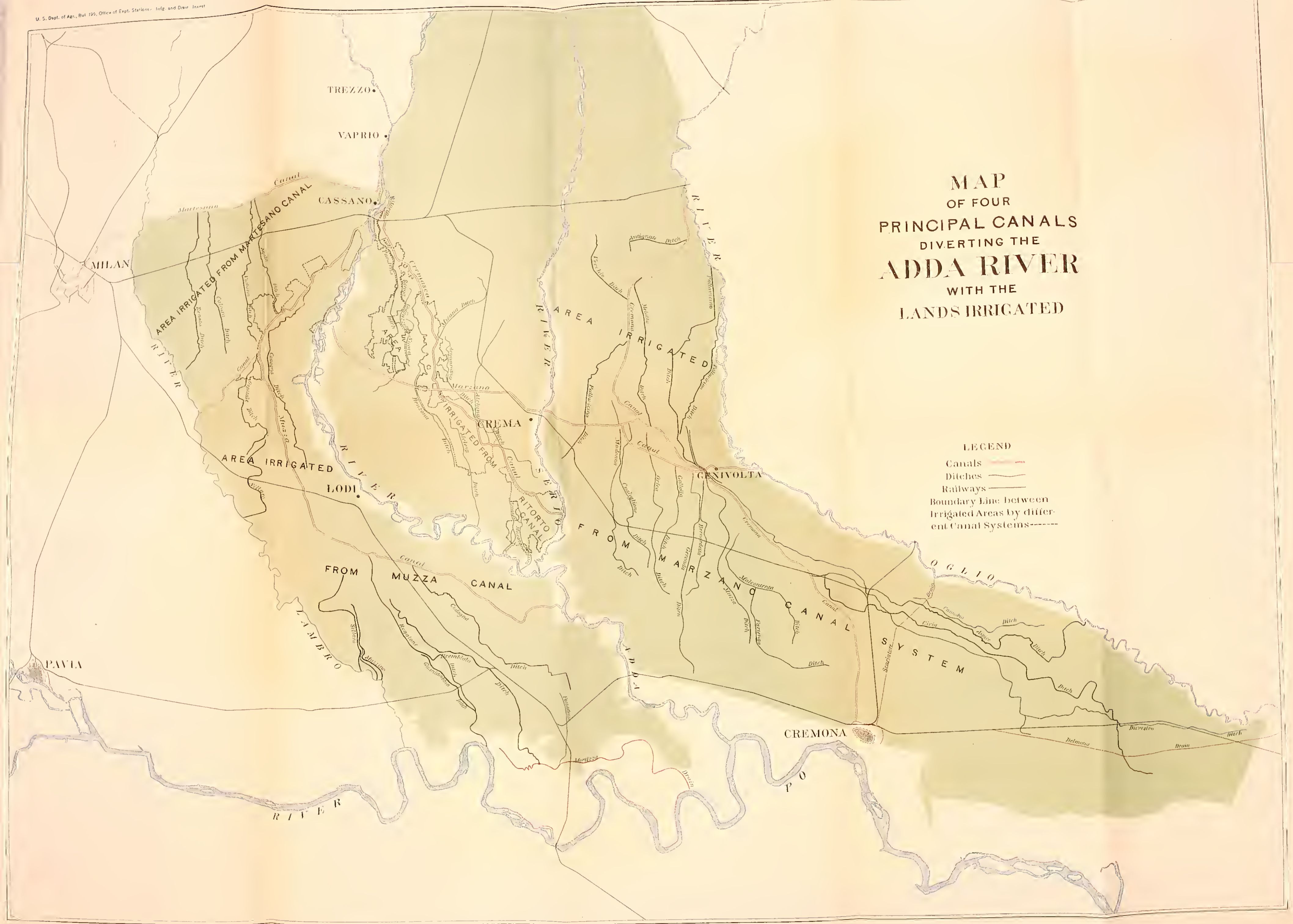




FIG. 1.—HEAD OF MARTESANA CANAL, SHOWING THE ABSENCE OF HEADGATES AND
RUINS OF ANCIENT POWER MILL AT INTAKE.



FIG. 2.—BRIDGE OVER ADDA RIVER. GAUGE ROD INDICATING DISCHARGE OF STREAM
IS ATTACHED TO ONE OF THE PIERS.

The first of these rights has a recorded history of seven hundred and fifty years, and there was manifestly a beginning back of that. It will be seen in the subsequent history of the four large systems dealt with that their evolution has developed about all the evils, and by contrast has resulted in about the most advanced ideals of water-right management to be found in any irrigated land. The Ritorto Canal shows what water users' associations can accomplish. The Muzza Canal shows the inherent evils in making water personal property, and the history of the Marzana Canal, only partially given in this report, shows how effective irrigation is as a training school for self-government, and it also illustrates the enterprise, public spirit, and capacity of the modern farmer in northern Italy. Here is a system founded in antiquity, rooted in prejudice, whose abuses are being uprooted and an equality of privilege substituted in their place. As a result of this, the province of Cremona has within the past thirty years become conspicuous not only in illustrating the operation of the best water laws, but also as possessing a body of irrigators capable of making the best use of those laws. The contribution of this river to the agricultural wealth of Italy is only partly shown by the service rendered by the four canals described (Martesana, Muzza, Ritorto, and Marzano). It is better shown by an examination of the irrigated area on the map, as these four canals together irrigate 250,000 acres. Before irrigation prevailed the lack of the needed rain in midsummer caused damage to some crops every year. It made intensive cultivation impossible. Irrigation has removed this hazard, and where it is fully established, the population has doubled; where it is being extended, the same increase is going on. On an average, each acre irrigated produces three times the crop of the acres not irrigated. But this river does more than contribute to the security and profit of the individual farmer. Under the enlightened code of Italy, the water as it flows in the channel is a State property, and as the owner of this property the State charges for its use. Rivers in Italy produce a large and direct revenue. The electric power plant at Trezzo, a short distance above the first of the irrigation canals, pays the Government \$10,000 a year for the water which turns its wheels. One irrigation company pays \$800 a year for the water which fills its canals. The lessening of tax rates by charging for power privileges, and the development of manufacturing industries by the State regulation of power charges through its ownership of the water, is doing much to make northern Italy not only the most prosperous part of that country but one of the most rapidly developing sections of Europe. The total rental which the Government derives from the river can not be determined, because it owns two of the canals and the charges for water can not be separated from the expenses of operation.

THE MARTESANA CANAL.

The Martesana is one of the three navigation canals built to connect Milan with the outside world, the other two being described in Part I. The Martesana, like the Naviglio Grande, derives its chief navigable importance at present as a means of transporting building and paving material to the city. Most of the sand and much of the terra cotta used in building operations in Milan float down this canal from the Adda. It also serves to carry the produce of the farms into the city. The boats are about 50 or 60 feet long, pointed at both ends. They float downstream and are towed back by horsepower. Power development here is extensive. At the head of the Martesana was a mill for grinding corn, three hundred years old. Although this machinery was not in use, the water was still pouring through its wheel in order to preserve its rights. Among the more modern and effective power plants inspected was an electric plant generating 17,000 horsepower, which serves to operate the street cars and light the streets of Milan. A cotton mill diverted some 700 cubic feet of water, but the horsepower generated could not be learned.

At the head this canal is 44 feet wide, but a short distance below it is widened to 52½ feet. The depth near the head is 9 feet, and except at the immediate head, where the current is so swift that the channel had to be paved, the current does not exceed 3 feet per second. The canal is 28 miles long, carries 1,000 cubic feet per second at the upper end, and discharges 100 cubic feet per second into the Vettabbia Canal at the lower end. Like all the old navigation canals of Italy, it has no headgate. A concrete dam 879 feet long extends across the river and holds the water up to a height sufficient to fill the canal. At the immediate mouth the current is very swift, reaching at the time of the writer's visit 10 feet per second. Five openings through the dam send the surplus and the water demanded by prior appropriators downstream, except in times of extreme flood, and then the dam is submerged and a series of wasteways along the Martesana discharges the surplus water which enters it.

Aside from its services to navigation this canal irrigates 54,340 acres. Like many of the older canal systems, the revenues from this and its administration are impaired by the large number of free rights which have been given away or sold in the past. The holder of a free right, it must be explained, not only obtains the water free, but he does not have to contribute anything to the expenses of keeping up the canal and delivering the water. The origin of these free rights was explained in Part I, page 29. They come either from ancient grants from the State to favored individuals or by payments made to the rulers of Lombardy.

One hundred and twenty-nine laterals distribute the water. Farm-

ers who live along these laterals are usually organized into independent companies or associations. They employ water masters and, where the laterals are large, engineers who act as managers. Some of these laterals also supply water to mills for power purposes. Some of these mills hold ancient rights and pay nothing for this power. One paper mill was visited. Its wheels are turned by a constant flow of 14.8 cubic feet of water per second. The right to this flow was bought from the Austrian Government when it ruled northern Italy, for a cash payment of \$9,650. Some of the farmers have to pay for the water that is turned into their laterals; some do not have to meet this payment, but have to pay their share of the operating expenses of the lateral, and some do not have to pay anything. This intermingling of full and partial charges makes any determination of the actual cost of water under this system most confusing.

Further confusion in studying irrigation in Italy grows out of the fact that irrigation is not a necessity, but simply an advantage. The 54,000 acres irrigated from this canal is not in a compact body, but forms a checkerboard in which 7-acre and 10-acre irrigated farms are interspersed among farms of equal size that are not irrigated. A farmer will have water for part of his land and no right for the remainder.

Irrigation, however, is continually extending and the area unirrigated every year becomes more and more reduced, but the rights for the areas now being brought under irrigation are governed by the modern water laws of Italy, and it often happens that an irrigator with 10 acres of land will have part of it watered under an ancient right with no charges and a part of it watered under a modern right with a full charge. In the latter case irrigators pay for water at the rate of \$156 a year for a cubic foot per second.

The conditions under one of the old rights are illustrated by a farm visited. The entire farm contains 32.4 acres, but this is subdivided and leased to a number of tenants. One has $6\frac{1}{2}$ acres. Of this, 1.6 acres is in hay, 1.1 in wheat, and 3.8 acres in Indian corn. The 1.6 acres of hay land had been in meadow for thirty years. It is cut three times a year. The corn and wheat land are rotated, crops being interchanged. The tenant pays \$19 a year rental for each acre of the hay land and \$14.30 for each acre of the corn and wheat land. He gets his water under a rotation arrangement, which gives him 7.44 cubic feet per second for four hours every ten days. For this he pays \$2.70 a year, or about 40 cents an acre. This is a free right, and the 40 cents pays only his share of the water master's services in regulating the gates. The price of this land varied with the crops. The hay land was worth \$335 an acre; the wheat and corn land, \$300 an acre. Unirrigated land in this neighborhood sells for about \$200 an acre.

THE RITORTO AND MUZZA CANALS—A CENTURY-OLD CONTROVERSY OVER WATER RIGHTS, AND THE WIDE DIFFERENCE IN MANAGEMENT AND CHARACTER OF WATER RIGHTS IN TWO ADJOINING CANAL SYSTEMS.

Four miles below the head of the Martesana Canal, on opposite sides of the stream, are the headgates of two important irrigation systems worthy of study because of their size and having lessons for the United States because of the light they throw on the evolution of irrigation laws and policies.

The Ritorto Canal is on the east side of the stream. It is owned and managed by a water-users' association, resembling in its organization and methods of doing business the Wright district organizations of California. The Muzza Canal, on the west bank of the stream, is owned by the State, and has been owned and operated by the reigning government of Lombardy for four hundred years. The Adda River does not furnish water enough to fill these canals. One or both of them are subject to a shortage every year. The difficulties of those called on to divide the water are enhanced by the fact that the river at this point has a sandy, shifting channel, which sometimes fills one headgate and increases the flow in the other; and this renders it difficult to determine whether the distribution of the water is in accordance with the legal rights of the two districts. We have here all the conditions for jealousy and litigation over water rights, and they have borne their usual fruit. Water-right quarrels have extended over four hundred years, and litigation for the past hundred years has been continuous. Bringing both under one government has not been sufficient to settle their disputes. On the contrary the water-right litigation waged during the past twenty years has doubled the charges for water under the Ritorto Canal.

The Ritorto is made up of two main branches, the Cremasca and the Pandina. The date of its beginning is not known; the oldest rules for the distribution of its water found in the archives of Venice were dated in 1374. At this early date the water was attached to the land; any farmer might divert water on the payment of a small tax, but he was obliged to indicate the area irrigated. The original canal—which was probably the Pandina branch—was enlarged in 1430 by the construction of the canal now called the Cremasca. Apparently this canal was built by the city of Crema, which was the capital of the western part of the republic of Venice, and its purpose was to extend the area devoted to the growing of flax. Venice was at that time the trade center of the civilized world, where the East and West met; it had need of linen to exchange for the gems, silks, and spices of the Orient, and Crema was the best district for growing flax. From the first the canal has been a suc-

cess. It was well built to begin with. The measuring boxes were made of stone, the gates were locked, the men who held the keys registered, the district which owned the canal had an inventory of the land, and the expenses of the canal were met by a tax on the land irrigated. Water could not be supplied to land not registered nor taxed, but new lands with new gates could be brought under irrigation by consent of the community. The Venetian Republic surrendered its rights perpetually to the district by decree dated 1450. The city continued to operate the canal until 1586, at which time an agreement was entered into by which the city was relieved of all obligation to pay any of the expenses of the canal, and it was turned over entirely to the irrigators, who were required to pay the city an annual tax of \$800. Although the general council of the city lost all interest in the financial operation of the canal, it had the power of appointing all its officers and directing its management, this status being maintained until 1797, when the complete management was turned over to the landowners of the district. For two hundred years, however, the irrigators have elected the water masters which manage the laterals. When the management was turned over to the water users, there was no official map of the lands entitled to water, nor register of those entitled to a voice in the management, the city's records being disputed. During the time Austria ruled this part of Italy this could not be changed, and there was much internal friction. It was not until the creation of the United Kingdom and the passage of the Italian laws of 1873 and 1876 that legal authority was given the district to complete the list of its members and reach an orderly settlement of its internal affairs. It was not until 1890 that the regulations which fixed the membership in the association and provided for its government were completed. These had to be submitted to the Government for approval, which was secured in 1892. As the subject of canal organization and management is destined to be of greater importance in this country in the future than in the past, the methods adopted by this association to "put its house in order" are worthy of study. This was accomplished through a series of regulations. The following abstracts show their character:

ART. 1. Prescribed that the lands then inscribed in the books of the assessor as being taxed for the benefit of this canal should from that date be considered the lands of the district, and that all the affairs of the district should be governed by the rules of co-ownership; that is, each acre of land within the district had an equal interest in the canal property.

ART. 2. Authorizes the association to take whatever steps were needed to maintain its rights against others, and to establish and maintain rules and regulations for the efficient distribution of water.

ART. 3. Provided for the official record of members in the association. Any changes in the ownership of land inscribed in the books of the assessor are to be reported to the canal officers, and any purchaser of land who has not had his name inscribed on the canal books has no right to vote at its meetings. All

changes in the assessor's books have to be recorded fifteen days before any canal meeting to give a new landowner a right to vote.

ART. 4. Provided for the establishment of prescriptive rights and permitted the inclusion within the association of any lands which had used water without contest for three years prior to the adoption of these regulations, even if the lands had not been taxed for the benefit of the canal. The users were obliged to report the area irrigated and have it immediately inscribed in the assessor's books and in the canal registry, and any claimant failing to make this report, or using water without being inscribed in the assessor's books, had to pay a double tax, and by the payment of this tax they did not acquire a right to become members of the association. So long as they use water they do so as outsiders, and must pay the double tax.

All of the gates through which water is regularly delivered are registered with the assessor. Those using water through gates not registered are not permitted to become members of the association, nor are they allowed to establish perpetual rights in the canal's water supply. Their use is only temporary and subject to cancellation at the will of the association. They are also subject to special regulations prescribed by the association. Under this canal are some ancient rights entitling the owners to the use of water without the payment of the tax. These are not permitted to become members of the association nor to vote at its meetings. Lands on which water has not been used for three years can be divested of their water rights and removed from the assessor's records.

ART. 5. Provided for the correction and making of new assessment records in accordance with the preceding articles and having all taxes for the benefit of the canal levied in accordance with this corrected list. In making this revised list the executive board was required to, as far as possible, bring about uniformity in the ancient rights. It authorized the central administration to make all necessary rules for the operation of the canals.

ART. 6. Provides that expenses of whatever kind in dividing water, keeping the canals in good order, defining the rights of the canal in litigation or otherwise, and constructing and maintaining buildings and gates and all expenses connected with the administrative and technical operation of the canal shall be made a charge on the members, and this tax is apportioned in accordance with the acres of land irrigated as shown on the assessor's records.

ART. 7. Provides that the water of the canal be allotted in proportion to the acres irrigated; that after the making of a new assessment roll the allotment of water to the different gates shall be revised as is necessary to bring about an equal distribution of the water under all the gates.

ART. 8. Provides that all members of the association shall have the same right to water and that each member must pay for water every year, whether he uses it or not. Waste and losses from seepage must be prevented as far as possible. Water for irrigation in summer is divided by rotation, each irrigator being given a large supply for a few hours. Water for winter may be by rotation or perpetual flow, as is considered most convenient.

ART. 9. This article commits the administration of the canal to an executive committee of three persons, one of these being chosen from each of the three sections into which the lands of the district are divided. All of the users inscribed in the assessor's records may vote to elect the executive committee; a member of the executive committee must possess at least 25 acres of land under the section of the canal which he represents. These members of the executive committee hold office for three years, and one is elected each year.

ART. 10. The executive committee has charge of the regulations governing the distribution of water and the business management of the canal. It defends the

rights of the association against nonmembers and, in general, protects the water supply of the association.

ART. 11. Each lateral ditch has an organization of its own, resembling that for the whole canal, and article 11 deals with the distribution of water from these laterals. There is an executive committee of three, elected from among the water users on each lateral. This executive committee appoints the water master for that lateral. This water master reports to the central executive committee all lands that are recorded in the assessor's books or lands that are entitled to a temporary right to water. This executive committee represents the lateral in all dealings with the central executive committee or with outsiders, and all the lateral committees constitute an advisory board for the central committee. All questions relating to laterals are first dealt with by the local executive committee and then reported to the central body with whom the local committee acts in official capacity. A man can not be a member of the central executive committee and of the executive committee on a lateral at the same time. If any individual irrigator has a grievance, he can not carry it directly to the general management of the canal; he must take it up first with the lateral committee, and this weeds out a great many complaints that would otherwise reach headquarters.

ART. 12. If the men along any lateral have not elected their water master or their three executive committeemen by the last of April, the central executive committee reports this to the general assembly of users, who order an election and shut down the gate of the lateral until it has taken place. The central executive committee can dismiss any water master for waste or a failure to report all the land irrigated during the year; it can fine him a dollar for every quarter of an acre not reported, and a fine of \$2 for every time he does not properly divide the water; these fines are deducted from his salary and put into the treasury as a part of the contribution to the general expenses from that lateral. Whenever there is a controversy between the central executive committee and the executive committee of one of the laterals the controversy is submitted to a board composed of the committeemen from all the laterals. To this board is given power to substitute water masters for those who have been elected and found incompetent or negligent, and the salary due the water master so substituted must be paid by the lateral as if he were appointed by their executive committee.

ART. 13. Where there is an exceptional shortage of water, making it impossible to supply all the laterals, the central executive board can rotate it between the laterals and provide any special rules to carry out this rotation, and those who irrigate land out of their turn must pay an extra tax of \$4 an acre for each acre irrigated.

ART. 14. In the general meetings each member has one vote for each 12 acres, and two votes for any acreage between 12 and 75 acres, and three votes for any acreage between 75 and 250 acres, and above that one vote for each additional 250 acres. One-half of the acreage must be represented in a meeting to constitute a quorum. Members may vote individually or by proxy; women or minor sons are not allowed to vote, but wives may be represented by their husbands and widows and single women by other representatives. Corporations of landowners may be represented by one member of the administration. All meetings must be announced by specially printed notice posted at least eight days in advance in all communities where there are lands recorded in the assessor's books. The annual meetings are in January; proposals to be brought up for discussion at this meeting must be presented at least twenty days before the meeting and by users representing at least one-fourth of the land

of the association. Inquiries at this regular meeting must be presented twenty-four hours before being submitted. Extra meetings may be called whenever necessary by 10 per cent of the water users or by all of the users from one lateral which supplies 250 acres which have not less than 15 water users.

ART. 15. The Pandina and Cremasca branches of the canal each form a separate district; each has a central executive committee. In the maintenance of the main canal above their union and in the general outside expenses the two executive committees act together. Three-fifths of the general expenses are paid by the Cremasca district and two-fifths by the Pandina district.

ART. 16. Any changes in the regulations must have the support of three-fifths of the land interested in the association, but no change can be made which curtails the interests guaranteed by the original regulations.

Articles 9 to 14 were modified at a meeting in October, 1900, in which a third branch canal, the Badessa, was added. The administration was committed to a central syndicate, with headquarters in Crema and consisting of nine members, three to be chosen from each of the three different branch canals. These nine members of the central committee are to be chosen at an election at which all of the men recorded in the assessor's books have a right to vote. To be eligible for election a man must be a registered irrigator, of legal age, who has never been guilty of a misdemeanor, who is not delinquent in the payment of his taxes to the association, who has no question pending before the canal administration. The executive committeemen elected to hold office for three years may be reelected and continue in office until a successor is elected and installed. They must personally attend the meetings; they can not be represented by a substitute. The nine members of the central syndicate choose a president by a majority vote. The president holds office one year.

The members of the Ritorto Association pay an average price of \$3.50 an acre for water. I saw the assessor's list of the water taxes to be collected. It varied from 4 cents, the smallest price paid by any farmer, to \$243, the largest price. If the water claimed by the Ritorto were taken as a basis, the average duty of water under this canal would be exceedingly low, less than 21 acres for each cubic foot per second; but the actual duty is much higher than this, because during the months of April and May the canal frequently receives less than 10 per cent of the water claimed or the amount which the canal will carry. Owing to the great shortage in the river, the actual duty of water under this canal could not be ascertained. The actual duty is not based on the necessities of the irrigators, but on what they can obtain, and it is much higher some years than others.

THE MUZZA, A STATE-OWNED CANAL.

Official documents dating back to 1155 show that a small canal existed along the same route as that now occupied by the Muzza. Other documents dated in 1183 show that the communes of Lombardy

were entitled to use water in irrigation. This seems to have been the beginning of the great Government canal, which irrigates nearly all of the territory of Lodi, or the district between the Adda, Lambro, and Po rivers, a district having 185,000 acres, of which 128,000 acres are either irrigated directly from the Muzza or with seepage water which this canal supplies.

It will help readers to understand the significant features of irrigation in the Muzza district to have pointed out in the beginning how they differ from those in the Ritorto district just described.

The Ritorto is owned by an association of water users; the Muzza is owned by the Government. Water rights under the Ritorto are attached to the land; water rights under the Muzza are personal property and can be sold or rented and shifted in use from year to year. Water charges under the Ritorto are based on the area of land irrigated; water charges under the Muzza, on an assumed volume delivered. Elected officers manage the Ritorto; State-appointed officers, the Muzza. One is a republic, the other a monarchy. Under one there is equality of service and charges; under the other ancient privileges are a tax on the canal management and on the actual user of water.

In 1515 Spain, then the ruler of this province, took possession of this canal, and whatever government has ruled the country since has owned the canal. For many years it has been a "white elephant." The present Government has tried to give it away and found no takers. The district it serves prefers to let the Government shoulder the deficit. This does not mean that irrigation is unprofitable; on the contrary, this is one of the most flourishing farming sections in the valley. The canal does not pay because it supplies water at less than cost, and it does this because the State charges the same price now that it did three hundred years ago, when \$1 had about ten times the purchasing power it has now.

• The charges for summer water and for winter water are separated and are based on two different units of measure. The price of summer water is based on the Lodi oncia, an ancient measuring device similar in principle to our miner's inch, but delivering a volume about thirty times as large.

Water delivered in winter is charged for by the mill wheels used. Charging for the mill wheels used grows out of the fact that when the water rates were fixed winter water was used wholly to run small mills located on the laterals. The mill wheel is larger than the oncia.

The rates for water were fixed in 1550 by the Duke of Milan and have not been changed, that for summer water being \$3.35 per Lodi oncia (\$4.20 per cubic foot per second); that for winter water, \$2.15 for each mill wheel.

Practically all the landowners under the canal have rights to water, but many of them do not use the water on their own land but exchange or rent the right to others. The extensive system of exchanges grows out of the fact that the canal has rights to about four times as much water as the river carries at some seasons each year. There is a shortage in April and May and again in December, January, and February. Those planting valuable crops rent the rights of others, who risk dry farming. In short seasons nearly all the water goes to the rice fields and meadows.

Poor control over headgates is another cause for the extensive renting of water. A farm near the canal rarely lacks water. Those at the lower ends of laterals are almost certain to have a short supply unless they can forestall it by renting the rights and closing the gates of their more fortunate neighbors above.

AGRICULTURAL CONDITIONS.

The soil in about one-half of this district is a coarse gravel, which requires a large amount of water. The surface soil is so thin that it does not pay to plow it much, and hence the practice has grown up of keeping it continuously in meadows. The crop rotation generally adopted is the following: First year, grain; second year, wheat; third, fourth, fifth, and sixth years, meadow, and seventh year, flax, then corn, "guarantino" or millet.

The lands are well and thoroughly cultivated. Dairying, chiefly cheese-making, leads, but rice has become a much more important product in recent years. Where rice is grown, the rotation period is eight years. In the whole of the territory irrigated by this canal, 52 per cent of it is in meadow, 18 per cent in wheat, the remaining 30 per cent is in Indian corn, flax, rice, etc. As in Piedmont and Lombardy, silk is an important subsidiary industry. Mulberry trees border every field and are sometimes planted within them. In the clay soils of this region the mulberry produces double the yield of leaves obtained on the dry lands north of Milan.

Mr. J. Battaglia, chief engineer of the Villoresi Canal, but formerly an engineer of the Muzza, kindly gave me the benefit of his intimate knowledge of this system. Fourteen questions submitted and his replies show how the water of this canal is distributed and used, both in the summer and winter months. In giving Mr. Battaglia's replies, the units of water measurement, money values, and areas are given as he stated them, for the purpose of showing how the old units have been retained. Wherever a comparison with our own practice is necessary to an understanding of these replies the relative values in cubic feet per second and in dollars has been given in parentheses:

Question 1. What is the normal price per Italian module for water supplied during the summer months, and is this price the same for lands near the head-

gate and for lands at the farther end of the canal, or is the charge based on the distance water is carried?

Answer. The State, the proprietor of the Muzza, makes the users pay the rental of 22 Milan lire for every Lodi oncia of continuous water—that is, 73 lire for an Italian module, considering the Lodi oncia to be 23 liters per second. This price is far from being the just value of the water, as is easily shown by comparing the prices paid for the rental of water under private agreements.

By the documents of the new catasto (assessment roll), now being made, we can have the prices paid for the water rented for the lands irrigated that have not special rights, in the Lodi Province and in the districts of Melzo and Melegnano, which use water diverted by the Muzza or by canals collecting water coming indirectly from it by seepage and waste or by springs on lands to which the Muzza distributes water.

Such data, collected in 1894, is included in the following table:

Rentals for water in Lodi.

District.	Area irrigated with leased water.	Cost of leased water per hectare.	Remarks.
	<i>Hectares.</i>	<i>Lire.</i>	
Melzo	104.4030	90.60 to 11.13, more frequently 30 to 47.	The lower price is not that fixed according to the demand for the water, but it is fixed by ancient perpetual agreements as a compensation for carrying the water.
Melegnano	631.3935	80 to 33, more frequently 52.73....	Do.
Paullo	143.1720	58 to 2.19, more frequently 25....	Do.
Lodi I	16.3850	7.5 to 36, more frequently 47....	Do.
Lodi II	840.4580	142 to 11.60, more frequently 42....	Do.
St. Angelo Lodi	1,237.6840	130 to 8, more frequently 50....	Do.
Borghetto	431.4070	121 to 6, more frequently 30....	Do.
Casalpusterlengo	1,491.4744	87 to 1	Do.
Maleo	587.2392	105 to 5	Do.
Codogno	709.4640	85 to 3	Do.
Total hectares...	6,183.0801		

From the remarks contained in this table we can state that not all this 6,183 hectares represents the lands irrigated with leased water whose price is determined by the value of the water, but in this are included the lands whose rental price for irrigation water represents only the compensation for the maintenance of the aqueducts, and does not correspond therefore to the real value of the water if sold in open trade.

The area of land that we would estimate to be irrigated with water leased at a just price is about 4,000 hectares, and the price varies from 25 lire to 80 lire, with an average price of 40 lire per hectare of cultivated land. It is possible to state the price of our module of continuous water on the basis of the area if we consider the use of the water according to the crop and to the number of irrigations; but it is easy to understand that the result would not be worthy of one's attention as the lands that apply for water are always of no great area and require only a small quantity of water without any agreement or obligation as to the period of rental or any other conditions, and thus uncertainty makes the price of the water higher. We can prove this by making the above-mentioned calculations.

Assuming that 1 Lodi oncia of continuous water is sufficient for the general irrigation of a farm of 300 Lodi perticas with the ordinary rotation of crops if the soil is clay and of 200 Lodi perticas if the ground is sand (agricultural

committee of Lodi), or, assuming that the average farm of 1,500 Lodi perticas, or 100 hectares, half sand and half clay, requires $6\frac{1}{4}$ oncias of continuous water, we would have the result of the use of 1.44 liters per second per hectare. With a module of continuous water we could irrigate about 70 hectares, so that using the average rentage price of 40 lire per hectare, the cost of the rentage of 1 module of continuous water would be 2,800 lire.

According to Lombardini, who thinks that 1 liter of continuous water is necessary to irrigate 1 hectare of cultivated land, we would have a result of 4,000 lire per 1 module of continuous rental water. These values are greater than the normal value of the water, in accord with the agreements made in the province of Lodi for the total amount of water necessary to one farm. According to notices received and the agreements we have seen, we estimate that the rental of 1 Lodi oncia of water costs 300 to 350 lire, making an average cost of 1,600 lire per Italian module.

(Converting the above into American equivalents, the nominal charge for water is \$4.20 a year for each cubic foot per second; but as about double the designated amount of water is delivered, the actual charge is about \$2.10 a year for each cubic foot per second. Wherever the original holder of the right rerents or resells it the charge varies from 90 cents an acre to \$8.14 an acre, and the average for the 15,000 acres having these rental rights is about \$3.20 an acre. If such rentals were continuous, it would mean a price of about \$90 per cubic foot per second.)

Question 2. Is a deduction made from the normal charge for water for the first, second, and third years that land is brought under irrigation as an offset to the increased expense of irrigation and to the outlay needed to prepare the land for irrigation?

Answer. Irrigation in the Lodi Province is ancient. All the lands watered are under irrigation. Hence there are no cases arising under the second question.

Question. 3. Where water is divided by rotation, how are the rotation periods fixed?

Answer. The rotation schedules are fixed by the engineer, who fixes the number of hours each user is to have a particular supply. In the entire system much of the land is supplied from seepage or drain ditches, and the manner of fixing these rotation schedules depends in part upon the nature of the ditch and upon the private rental agreements which control the water supply.

Question 4. Are charges for water (under subleases or private agreements) based upon a particular flow or on the area watered? What is the approximate amount of water used for the different crops and for different kinds of soil?

Answer. Nearly all the rentals are graded according to the area watered. The grantor obliges himself to deliver to the grantee the amount of water necessary for the irrigation of the land, according to the crop, subordinate to the condition that the grantor has a sufficient quantity of water for his own needs. Generally the grantor is a farmer or a proprietor adjoining the property of the grantee, so that he can himself allow the necessary water to run down, opening a part or the whole of his canal during the time determined by practice. Generally in the agreements no mention is made as to any difference in the quality of the land to be irrigated, and nothing is said about the level and the location of the lands, as the concession of the water includes a guaranty that the water will reach the lands to be irrigated. As for the crops, it is to be remembered

that in the lands where the water is rented rice and marcite (a mixture of clover and Italian rye grass) are not cultivated, as these require a great and continuous quantity of water. In the territory of Lodi they use it only in emergencies to irrigate wheat, so that the crops on the lands of those who lease the water are generally limited to meadows and Indian corn. In order to estimate the amount of water used according to the different qualities of lands and crops we shall use the data gathered in a study that has not yet been finished, but which will soon be finished by this Office.

Rice.—For rice two quantities of water are necessary—one for filling the field, the other for the continuous refilling (keeping the surface covered). According to the practical data taken from a book by De Regi, accepted by many, 1 Milan oncia, 35 liters (or 1.23 cubic feet per second), is sufficient to irrigate 41.58 Milan perticas (6.71 acres) in forty-seven hours. There is required for each hectare 2,177.2 cubic meters of water, equivalent to a depth of 0.2177 meter (8.5 inches). For maintaining the growth of rice it is necessary to use on normal ground half a Milan oncia (17.5 liters per second) on 200 Milan perticas, equal to 13.08 hectares (32.3 acres). This is equivalent to 1 cubic foot per second to 53 acres.

Marcite.—From the agricultural committee of Lodi we know that for the territory of Lodi 1 legal module of continuous water is sufficient to irrigate $2\frac{1}{4}$ hectares of marcite in clay land and $1\frac{1}{4}$ hectares in sandy land. On an average a marcite field requires 3.4 times as much as a rice field.

Meadow and miscellaneous crops.—The amount of water used for the irrigation of a meadow is less than that necessary for flax, Indian corn, or wheat, and still, according to the experiments made by De Regi, in normal ground the amount of water used is in the proportion of 12 to 20: where 3 liters are required for a given area of meadow 5 liters are required for the same area if cultivated.

By calculations made for the Muzza (left out in order to be brief), it is stated that the average amount of water for each irrigation with a rotation period of seven days is 2.15 liters of continuous water per hectare—2.780 liters for the cultivated land and 1.688 liters for meadows. This is equal to an amount of water used for each irrigation in a period of seven days per hectare: For meadow, 1,008.80 cubic meters; for cultivated land, 1,687.34 cubic meters. It should be noted that, except for flax, which requires more frequent irrigation, for wheat, and Indian corn, three irrigations are necessary on an average during the summer season, while the meadow requires an irrigation once every twelve days except during the months of April and May, when the number of the irrigations can be reduced to two.

Question 5. Where water is charged for by the area irrigated, what is the price per acre for the different crops, as rice, meadow, millet, and marcite (for these it is understood the price will be for each irrigation)? Tell also whether the price is uniform, regardless of the amount used or proportional to the amount used, or whether it is a flat rate with a fixed maximum limit.

Answer. We have already given the price per hectare for the area irrigated. That covers nearly all the meadow culture and a little wheat. In the rental agreements there is no difference as to the crop, nor is the number of irrigations fixed. It is obvious that the grantor, in fixing the price of the water, will consider all these circumstances. From this results the difference in prices given above. The rentals are made for small areas of land, and therefore it does not happen that a maximum limit is fixed.

Question 6. What is the normal price of each Italian module of continuous water during the winter season? (See question 1 for a joint question to be considered also in this answer.)

Answer. On the Muzza Canal the winter water is not measured by oncias, but by the number of mill wheels that are to be found on the diversions and on which the State takes the ancient rental of 14 Milan lire per wheel, equal to 10.75 Italian lire. There are a certain number of gates (27) that, as they have no right to the winter water, are allowed to get the water through a rental, paying the above-mentioned rent of 14 Milan lire per mill and a very reduced rent for water used for watering animals and for the manufacture of ice.

In the case of these concessions it was forbidden to use the water for irrigation. At present, in accord with the studies and the proposals of this office, the agreements for water rentals during the winter season from these 27 gates were modified and the use of the water was unlimited, and a price was agreed upon according to the quantity of water used. As for the prices stated by this office, we based them on the following considerations, strengthened by investigations made on the place:

It is generally considered that 1 Lodi oncia of water during the winter season costs for its rent 50 lire, if it is continuous. Considering the conditions of the Muzza Canal, that during the winter season is reduced to a discharge of 20 cubic meters (900 cubic feet per second), the possible claims of the gates having rights to continuous flow, and the conditions required in granting the concessions, the price of 50 lire was reduced to 25 lire, and afterwards to 20, on account of unforeseen accidents, misfortunes, as rigorous weather, muddiness, etc. This price is equal to about 100 lire per Italian module. To the industrial establishments of South Lombardy the spring waters (cold) are sold at the rate of 45 lire per magistral Milan oncia, or 128 lire per Italian module; and those of the rivers (warm) are sold at the rate of 4 lire per Milan pertica of marcite (60 lire per hectare).

The waters of the Muzza, which are cold and not continuous, have a much smaller value—that is, 3 lire per Milan pertica (45 lire per hectare).

The waters of the Muzza during the winter season are used for irrigating 2,000 hectares (5,000 acres) of marcite, but chiefly for watering animals, for manufacturing ice, for fire protection, and for agricultural industries, such as mills for wheat, Indian corn, rice presses, etc.

Question 7. Can irrigators arrange to obtain water for one day or a few days?

Answer. This does not happen in the Lodi territory.

Question 8. What are the limitations on the delivery of water through the distribution gates?

Answer. There is no other limitation than that the water shall be properly used.

Question 9. Does the canal administration guarantee delivery of full amount of water sold?

Answer. The State, in the distribution of the water, either in the summer or in the winter season, does not assume any obligation as to the amount of the water granted, and it is the same with rental agreements. Therefore no reduction of rent is ever made to users in case of deficiency. The same condition is agreed by private persons who rent the greater amount of water.

Question 10. Is there any deduction made in the charge for water when the full amount is not delivered?

Answer. It is certainly just to require payment only for the water really delivered, and it is also practically possible to ascertain the reductions in the distributions in the well-constructed canals in which the water is nearly always at the same level. But for the Muzza it would be very hard, because of its inferior construction and because of the variations of its discharge. The prices

fixed for the water in the Lodi territory take into account this irregularity, and the inconveniences are reduced, as the lands generally are rented for nine years, so those who purchase water have always a long period before them in which they may recover for the years during which the waters are deficient.

Question 11. In the case of a total stopping of the supply is any reimbursement made?

Answer. The State does not give any reimbursements in this case either.

Question 12. In case of a long shortage of water is it distributed in rotation?

Answer. This happened in the Muzza Canal, where in the past century the whole amount of the waters of the canal was distributed in rotation in the case of extreme deficiency. This useful custom was not applied in this century, but it is to be hoped that we shall be able to do so, as in this way we could prevent much damage and many conflicts of interest, and we could have a remedy for the greatest waste in the distribution of the waters.

Question 13. Are special concessions made under any circumstances; and what are the conditions?

Answer. We do not know of any special concessions.

Question 14. What are the prices for power for agricultural use?

Answer. The Muzza Canal is an irrigation canal, but its diversions supply many factories, all of little importance. The State receives 14 Milan lire per each mill wheel, with the exception of 27 gates on the Muzza, for which, as we said (see No. 6), the agreements for the rental during the winter season were modified not long ago. For these mills, as they are nearly always small and nearly equal in size, a rent was fixed at 1 lire per day for each wheel, counting only the days when they are running, and afterwards this was reduced to one-fourth to not increase greatly at once the preceding rental. Among private parties the rental is made on the number of horsepower actually delivered. We can say that for the agricultural industries in the Lodi territory the power for small plants is rented at the rate of 80 to 100 lire (\$16 to \$20) per horsepower.

Engineer Battaglia, who kindly furnished the foregoing data about irrigation under the Muzza, also furnished the following data regarding water rates under the Villoresi Canal. These data concern only the Corbetta and Magenta districts.

Water during the season from June 30 to September 8, costs 0.80 to 1.15 lire per Milan pertica—that is, 12 to 17.25 lire per hectare, according to the fertility of the ground. Each diverting gate delivers 200 liters per second in a period of seven days. On an average, three minutes are required to irrigate 1 pertica. (Seven cubic feet per second irrigates 1 acre in twelve minutes.)

The water is delivered by the canal company at the head of the lateral canal. As the amount of water is always abundant, we can say that all of the 200 liters go to the land. The water is measured by a weir. The drain water is lost. During the spring season the general conditions are nearly the same, with the exception of a longer period of time for the irrigation, as it is nearly all meadow land, with the exception that the price is raised for the period to the 8th of September to about 2 lire per pertica.

The association water is continuous, is rented during forty years, with a gate of about 190 liters at the intake, at the rate of 30 lire per hour, with a rotation period of seven days. After forty years the water remains as a right.

Both the water from drains and springs and the association waters are given by the canal company to the members of the association that have contributed to the construction of the secondary laterals and distributary canals and contribute to their maintenance. Those that are not members and can not be included,

therefore, in the above-mentioned agreement, pay a rent of about 45 lire per hour for 200 liters, and in a period of seven days 15 lire is the compensation to the society.

Two hundred liters an hour, in a period of seven days, irrigates 10 to 12 Milan perticas, or 0.66 to 0.80 hectare. There is no compensation for deficiency or for the stopping of the water in the periods before the 15th of April and after the 15th of August. In the case of a long period of deficiency the period is made every eight days or more. There are no rice fields or marsh meadows (water fields).

THE DIVISION OF THE ADDA RIVER BETWEEN THE RITORTO AND MUZZA CANALS—PHYSICAL OBSTACLES TO BE OVERCOME IN SECURING A SATISFACTORY DIVISION, LITIGATION OVER WATER RIGHTS, AND THE RESULT.

The Adda River has a shifting sandy channel where water is diverted for the Muzza and Ritorto canals. An island divides it in two branches. The Ritorto starts from the east branch, the Muzza from the west (fig. 1). At the head of the island is a power plant. The canal for this is taken out on the west side of the river and the water wastes from the power wheels into the Muzza Canal. This power plant was originally a small hemp mill, but it has been enlarged during the present century until it is now a large flax and hemp factory and an electrical power plant combined, the whole enterprise being owned by the National Flax and Hemp Society (Limited). With the enlargement of the power works more water was diverted. To secure this, the power company built a dam entirely across the river, which enabled it in low water to cut off part or all the water which would otherwise have run down the east branch to the Ritorto Canal. As all the water from the power wheels escaped to the Muzza, the building of this dam was directly to the advantage of the Muzza's irrigators. Even with this advantage there is a marked shortage in May, December, January, and February under the Muzza. The reason for this is that the low-water flow of the Adda River is 1,300 cubic feet per second. The Martesana, farther upstream, can divert about 1,000 cubic feet per second; the Ritorto claims 847 cubic feet per second, and the Muzza 4,305. There are therefore 6,152 cubic feet per second to be supplied out of a stream which falls to 1,300 cubic feet per second, and this leaves out of all account the small power plants and small irrigation ditches.

Figure 1 shows the location of the headgates of these three canals. The power dam, the chief grievance of the Ritorto, was built under an ordinance of June 3, 1857. This ordinance provided that the power company must not injure the Ritorto's rights; in case of complaint the water turned into the power canal must be reduced, and the power canal was also required to indemnify the Ritorto for damages. A further concession was given the Flax and Hemp Society in 1880, under which the dam was both raised and extended.

The result was that the eastern channel was filled up with sand, greatly reducing the volume of water entering the Ritorto, and causing that district to bring a suit in 1887, which is still being prosecuted.

There had been litigation, however, before this. In 1501 there was a controversy between Crema, the owner of the Ritorto canal, at this time a Venetian city, and the town of Cassano on the west side of the river in what was then French territory. The King of France delegated two of his ministers to settle this controversy and then define the rights of the Ritorto, and the King of France and the Senate at Venice in 1502 confirmed their decision. The controversy was, however, renewed and another decree was rendered in 1510, which was intended to be a final settlement of these rights. This decree designated the kind of gates that should measure the water turned into the Ritorto. They were built in the precise manner prescribed, and the decree was finally recorded in 1551. It was again recorded in Mantua in 1786, over two hundred years later, where it was said that an agreement between the Republic of Venice and the Emperor of Austria provided that the Ritorto Canal should have the right to maintain these works according to the decision of 1510. This agreement was the basis of a suit brought in 1887 against the National Flax and Hemp Society. The questions raised were submitted to a commission of three experts, who were to collect information on the following points:

What is the quantity of water diverted at present by the power canal, and also the condition of the river before the enlargements made previous to the changes in the dam made in 1857; how much the water supply of the Ritorto had been diminished by this dam; what changes should be made in the headgates of the Ritorto and in the dam of the power canal in order that the rights of the Ritorto might not be damaged.

In its defense the power canal denied that it had increased the amount of water diverted; held that it had established a right by prescription dating back to 1411; claimed that the Ritorto had changed the location of its headgate, and that the court had no jurisdiction to determine what kind of structures could be built in the river. The court overruled the demurrers of the power canal company and appointed a commission of experts to determine whether the actual diversions of the Ritorto Canal corresponded now to the conditions prescribed in the decree of 1510; and, if they did, it was to ascertain whether the works built at the head of the power canal had resulted in any damage to the Ritorto Canal in the low-water period. If this was answered in the affirmative, the experts were to determine the extent of the damage to the Ritorto and to outline what works should be built to give this canal its proper supply. The report of this com-

mission was submitted in 1890. It held that the diversions of the Ritorto were in accordance with the decree of 1510 and that the works of the power company, authorized in 1857, had damaged the Ritorto. The commission further decided that the power company was entitled to 8 cubic meters per second. It fixed the amount of water which the Ritorto was entitled to take and the damages to be assessed against the power canal if it took more than it was entitled to, fixing also the plan of the headworks to give the power company its 8 cubic meters per second. The power company took an appeal from this decision in 1891 on the ground that the Government had fully approved the works that it had built, and also that the Ritorto had no authority to change the plans of its headworks or clean out its canal so as to obtain more water in times of scarcity. They proposed the appointment of a new board of experts to go over this whole matter.

In 1895 the dispute was again submitted to a commission of three engineers, named by the commissioner of public works, who were required within two years to propose a plan for dividing the water of the Adda between the three canals. This commission made its report in 1897. It had made an exhaustive list and presented an elaborate report dealing, first of all, with the amount of water appropriated under the Muzza and Ritorto canals. In attempting to reach a conclusion about this the commission found itself perplexed by the differences in the water rights under the two systems. Under the Ritorto Canal water was real property and attached to the land. All that was needed was to determine the areas irrigated and the duty of water. Under the Muzza, however, water was personal property, held independent of the land served, and, as has been before explained, shifted from year to year to different areas of land through the wholesale plan of renting water rights which prevails there. Because of this, the same piece of land is sometimes watered from one lateral and sometimes from another.

Another question which the commission had to decide was whether land irrigated by seepage water should be credited to the irrigated area under these canals. Under both systems seepage water was an important factor. Drain ditches have been built to collect it, and the water from these drains is turned into irrigation ditches farther down the slope, making it impossible to tell how much is irrigated from seepage and how much from the water turned directly from the canal. In its effort to get at the facts as to the lands irrigated, the commission asked the managements of the districts to answer the following questions:

1. Give the land irrigated directly from the water of the Muzza and Ritorto; that is, the water supplied from laterals heading in the banks of these two canals.

2. Give the land considered as irrigated indirectly from these canals; that is, land irrigated with drainage water drawn from the land irrigated directly from the canal.

3. Give the area irrigated in summer and the area irrigated in winter.

The management of the Muzza Canal gave definite answers to these inquiries. The management of the Ritorto evaded a direct response, claiming that it was impossible to distinguish between the water supplied directly for irrigation and the water which came from springs and seepage. The commission therefore framed a new set of inquiries, as follows:

1. Whether the amounts allowed should be based only on those lands having rights to irrigation or include others for which irrigation was temporary.

2. Whether the allotment should include land irrigated by drainage water coming originally from the canals.

3. Whether the allotment should include land irrigated with water from springs where these springs have their origin in seepage water coming either from the canals or from the fields irrigated.

The first question was intended to clear up an uncertainty growing out of the practice of renting water under the Muzza, and to prevent duplication by the owner of the right and the man who used the right under a rental agreement, both claiming rights; that is, the water not being attached to any land, all the land sometimes irrigated could not be made the measure of the right, as it was under the Ritorto.

With respect to drainage, the commission could not discriminate as to how much land was irrigated directly from the canal and how much from seepage water. They did, however, divide the land into two classes, that irrigated by living drainage and that by dead drainage. The living drainage was the waste water gathered from land watered directly from the canals, and dead drainage was the water collected from the seeped lands in the bottoms and sometimes not joining the lands irrigated directly from the canal. In their final report the commission cut out all dead drainage under the Ritorto, but included a part under the Muzza, this being due to the shifting character of the water rights. All water from springs was excluded under both canals, as the managers of both systems were inclined to claim all spring water, whether its origin in the canal could be shown or not.

The commission gave the Muzza Canal a right to 3,784.6 cubic feet per second for the irrigation of 106,007 acres of land, this being a duty of 28 acres for 1 cubic foot per second; and the Ritorto a right of 713.5 cubic feet per second for the irrigation of 15,812 acres of land, or a duty of 20.7 acres for 1 cubic foot per second. If the volumes allowed were actually used, these would be the lowest duties on record, but not one-third of the water allotted runs in the stream at low water, and hence the actual duty is probably three or four times this theoretical duty.

STUDIES OF THE DUTY OF WATER.

The commission made a study of the duty of water, taking into consideration—

1. The crops raised on the lands.
2. The nature of the soil, whether clay or gravel.
3. The seepage from the canals.
4. The distance of the lands from their respective sources of water.

In its report it found that the crops have changed greatly in thirty or forty years. Flax growing is not as important as it was formerly. Dairying has become much more important and is now the leading industry. This has increased the acreage in meadow land and changed the rotation period as given previously in the report. In some parts of the country where it is very gravelly it has been found profitable to establish permanent meadows to prevent the leaching of the soil. Twelve per cent of the land under the Ritorto is now in such meadows and 55 per cent in temporary meadows. Under the Muzza Canal 63 per cent of the land is in permanent and temporary meadows.

The commission gave the power canal a prior right to 409.5 cubic feet per second, and this was equivalent to giving the Muzza Canal a priority to this amount, because all the water that went over the power wheels went to the canal below. For the remainder of the river the commission did not recognize either management as having an exclusive priority, but arranged a scheme by which each would take part of the increased flow until both rights were fully supplied. The Muzza was to be entitled to 11 cubic meters per second when the flow was 12 cubic meters; the Ritorto, the balance. When the flow was 14 cubic meters per second the Muzza was given 12.85 and the Ritorto 1.15, or one-sixth of the increase. Approximately the Muzza was given one-sixth of the increase in the volume from 12 cubic meters up, although when the flow became larger the percentage of the Ritorto diminished. At 50 cubic meters per second the Muzza obtained 37 and the Ritorto 13; at 90 the Muzza's share was 71.7 and the Ritorto's 18.3; when it became 132, the Muzza took 110.3 and the Ritorto 22.7. In the winter months when the flow was 96 the Muzza took 84.5 and the Ritorto 11.5; when it was 110 the Muzza took 96.8 and the Ritorto 13.2.

The decision of this commission was appealed from and the reason stated for the appeal is that the commission failed to answer the questions submitted to it by the court:

1. Whether the present state of diversions from the Adda correspond with the decree of Panigarola, 1510?
2. Whether the works authorized at the head of the Cassano by the public administration in 1857 resulted in damage to the existing rights?
3. What are the rights of the Cassano?
4. What are the rights of the Ritorto?

5. What damages, on the basis of rights determined, have resulted to the Ritorto from works authorized to be constructed by the Flax and Hemp Society?

6. Whether the existing works resulted in the Cassano securing its rights and whether the Ritorto is injured in the condition of its rights?

The representatives of the Ritorto claimed that the commission ignored the first three questions, and in ignoring the third evaded all the rest.

In the case now pending the Flax and Hemp Society claims that the Muzza Canal is prior in right to the Ritorto and that the Cassano had the right to divert and use the water belonging to the Muzza and waste it into the Muzza after having used it for power. The Ritorto admitted the priority of the Muzza, but claimed its rights under the decree of the senate of Milan and denied the right of the Cassano to the use of the water of the Muzza. This litigation was still pending in 1903. The archives of Venice have been ransacked for evidence as to early legislation and treaties.

This record is given to show that human nature and the results of litigation are surprisingly alike in Italy and this country. In the number of suits and the ingenuity of lawyers to find causes for appeals there might be substituted for the Adda the Arkansas, the Platte, or the Los Angeles.

IRRIGATION IN THE CREMONA DISTRICT—A SUCCESSFUL DISTRICT ENTERPRISE, CONSOLIDATION AND IMPROVED OPERATION OF OLD WORKS, AND THE CONSTRUCTION OF A COSTLY CANAL TO PROVIDE A SUPPLEMENTAL WATER SUPPLY CARRIED OUT BY A WATER-USERS' ASSOCIATION.^a

South and east of the Ritorto district is the province of Cremona, noted for its violin makers and for the independence and valor of its people in the many wars which have marked its past history. Although this is one of the oldest irrigated sections of Italy, irrigation methods and the profits of irrigation have been completely transformed within the past twenty years through the efforts of the modern water-users' association. By consolidating the old ditch systems, introducing a supplemental water supply, and handling a lot of discordant priorities as one system the area watered has been largely extended and the recurring droughts of many of the older districts eliminated. It is believed that this consolidation of priorities and the association of all the irrigators on a stream in one body is

^a The data relative to the Marzano Canal were obtained from a conversation with Engineer Valcarengi in 1903 and from a very admirable monograph prepared by him and published in 1906, and from a report on irrigation in Cremona prepared for this Office by Mr. E. M. Blake.

in the line of progress in this country and this warrants a full history of this Italian consolidation.

The province of Cremona is a long, narrow territory, bounded by the Adda, the Oglio, and the Po. As regards irrigation, it is divided into three zones, having as centers the cities of Crema, Cremona, and Casalmaggiore. In the first two of these the greater part of the land is irrigated; in the last, only about one-third, owing to the shortage of water. The Cremona zone is the largest and contains 244,750 acres. Previous to 1891 it was irrigated almost entirely with water from a series of ancient canals which had been the property of the aristocratic Pallavicino family. The city of Cremona was the owner of a canal called the Civico Naviglio, 36 miles long, with a capacity of 1,000 cubic feet per second. This canal was begun somewhere between the tenth and the fourteenth centuries and was the highest, largest, and oldest canal taking water from the Oglio River. Following downstream from it came the various canals of the Pallavicino system, which had acquired by purchase from the city of Brescia, the original owner of the river, a right to all the water not appropriated by the Civico Naviglio, conditioned on the payment of an annual rental of \$216.

The Oglio is a foothill stream which becomes very low in midsummer. Hence all the farmers depending on the Pallavicino system suffered from shortage of water and frequent and disastrous losses of crops. In the eighteenth century many new ditches were built higher up the stream. Farmers desired to follow more intensive cultivation, and for this needed more water. The timber was cut off the foothills and the swamps around the headwaters were drained. This tended to increase the flood flow, lessen the summer flow, and to aggravate the losses from drought by the Cremona farmers. All this fell on the users from the Pallavicino canals, owing to the Civico Naviglio having the prior right, and under the Pallavicino canals the losses fell chiefly on those least able to bear them. This canal system was a conspicuous example of the evil of ancient abuses. While the general plan was to charge an annual rental for the water furnished, in the past its management had sold from time to time perpetual rights which entitled the purchaser to water free of all charges, and to have the quantity bought delivered free of all diminution. Hence in dry seasons whatever water the canal could obtain went to those who paid nothing for keeping up the system. The effort to get an additional water supply was begun in the eighteenth century by developing water much as is done in southern California. Springs were tapped, drains to catch seepage water were built; but these did little to supply the increased needs or augment the lessened flow, so that by 1790 in dry seasons only about one-fourth the water that was needed was furnished. This situation continued until 1868, many

abortive efforts having in the meantime been made to increase the water supply, but in the year named it was definitely resolved to build a canal from the Adda River, and a committee of landowners was formed for this purpose. For thirteen years this committee had a trying experience. In rainy years irrigators lost all interest in the project, in dry years they had no money to spend on it; but the drought of 1879 was so severe that the committee was able to secure a subscription of \$2,000 to meet the expense of securing a concession of water from the Government. Eighteen hundred and eighty-one was another dry year, the loss of crops amounting to over \$1,500,000, and after this there was no lack of popular support.

But there were outside obstacles to be overcome. It was difficult to obtain a water right. The users of the Ritorto Canal objected on the ground that the supply canal would cross its irrigated lands and cut off the seepage water. The water users under the Muzza Canal filed fifty-seven objections based on a claim that its irrigators had an ancient right to build a canal lower down the stream to divert any surplus water. In 1882 the project was finally gotten under way. Taking advantage of the general law for the aid of irrigation through district organizations, the landowners of Cremona selected sixty-two deputies, the province forty-two additional ones representing various other interests, and these, with the local agricultural society, united to form a water-user's association. The city of Cremona subscribed \$154,400 in aid of the canal. Fifty-nine communities subscribed for 103 shares in the water-user's association and agreed to pay \$193 on each share, and they have paid each year from \$58 to \$177 on a share. This annual contribution was intended to meet running expenses until the income from water rentals was sufficient for this purpose.

The first work of the association was to build a canal to bring in an additional water supply. This canal—called the Marzana—is 24 miles long, has a right to divert 530 cubic feet per second, and can carry 875 cubic feet per second. At the head it is 83 feet wide on the bottom, with an average slope of $1\frac{1}{2}$ feet to the mile. The banks have a slope of $1\frac{1}{2}$ horizontal to 1 vertical, and are 8 feet high.

The canal cost \$1,350,000. Running through an old irrigated section and crossing the drainage lines, its construction was costly and difficult. Near Genivolta it crosses, within a mile, thirty-five pre-existing canals and headgates (fig. 2). Running through a densely populated and highly improved country, its course is continually intercepted by the network of ditches, drains, roads, and railroads already built, and all this in addition to the crossing of the Serio River and the numerous small creeks that intercept its route. The declaration of the Government that this was a work of public utility gave it the right to condemn property for its right of way, but the settlement of damages was a trying task and involved many lawsuits.

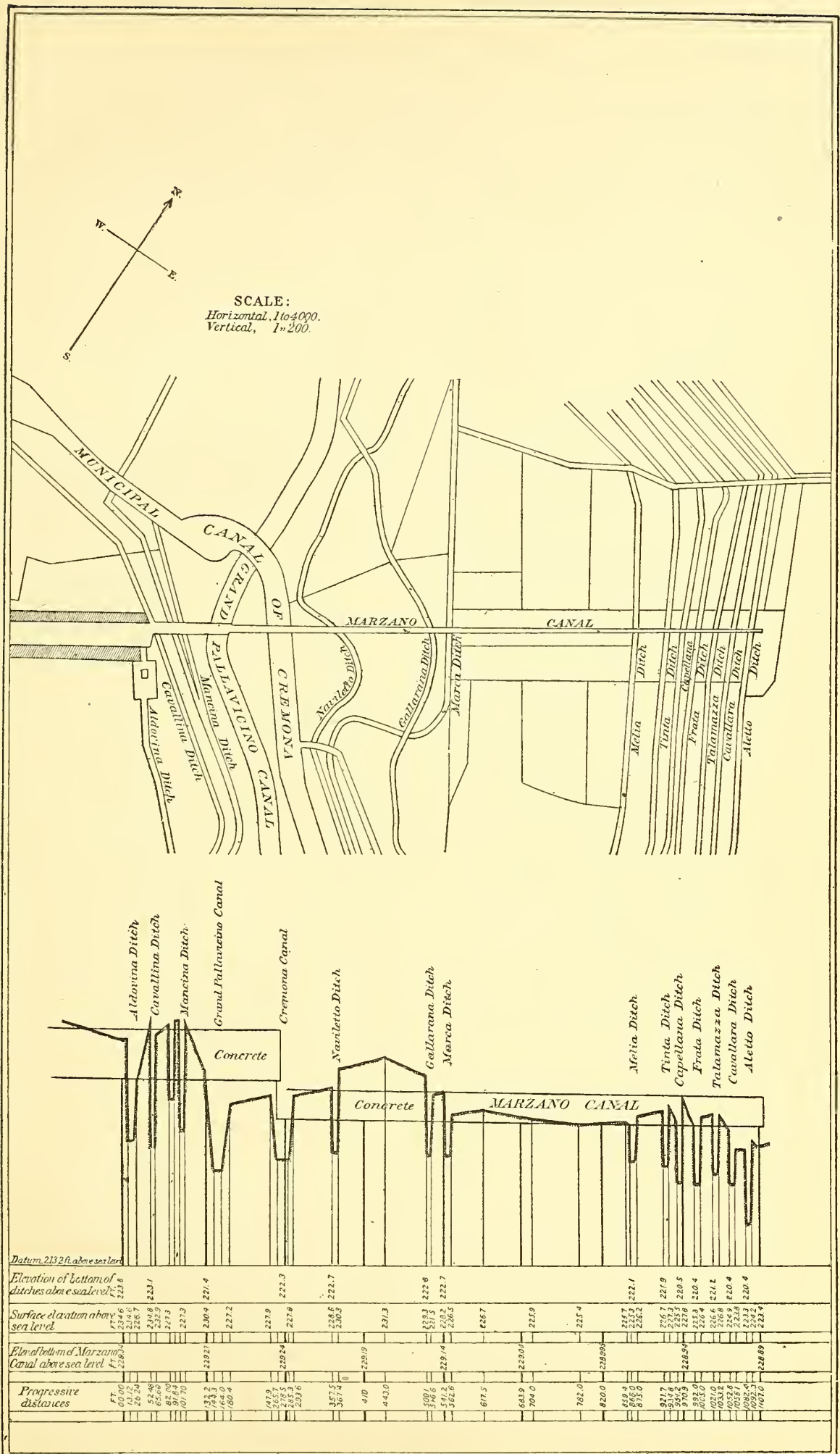


FIG. 2.—Plan and profile of the Marzano Canal crossing older canals and ditches near Genivolta.

Although planned and built by the district, the government engineers had a supervisory power over both plans and expenditures, but this was only a form; only three visits of inspection were made and no changes in plans or expenditures were required.

THE DISTRIBUTION OF WATER FROM THE MARZANO.

The original plan was to build this canal and then sell the water it carried by wholesale to the canals already built. To this end the association sought to make contracts with existing canals as far back as 1886. A schedule of wholesale rates was fixed, the charge being \$112 a year for a cubic foot per second for summer irrigation and \$11 a year for the same amount of water for winter irrigation, or \$123 for a twelve-month delivery. A reduction from this rate was made on long-time contracts and a thirty-year agreement was made with the Cremona Canal to supply it with 283 cubic feet per second. Two other twenty-year contracts for small quantities of water were made and then the demand ceased. The Pallavicino system, which watered the greater part of the territory, refused to buy. In 1893, two years after the canal was completed, only 358 cubic feet per second out of the whole appropriation of 875 cubic feet per second were being sold. The management of the Pallavicino Canal endeavored to get irrigators under it to buy an additional water supply, but the water users refused. The only chance for marketing the water seemed to be in the southern part of the province in the dry district, but to do this it was necessary to either build new canals to reach this section or utilize the canals of the Pallavicino family. The latter was cheaper. Through fortunate conditions the company was able to buy the entire system for \$386,000. It would have cost over \$2,000,000 to have built what was needed. This purchase included 155 miles of main canal and gave a right to all the water of the Oglio not appropriated by the Civico Naviglio. The Pallavicino canals all headed too high upstream, however, to gather in the return seepage water, and to secure this the association built some canals heading farther downstream on the Oglio, at a cost of \$200,000. This made the total expenditure on the system as follows:

Name of contributor:	Amount.
Water Users' Association.....	Unknown.
Province of Cremona, bonus	\$160, 020
Bank of Government Deposits and Loans, advanced with Government subsidy as security.....	330, 493
Sale of association bonds.....	482, 500
Loan by the savings bank of Milan.....	853, 542
Loan by the People's Bank of Cremona.....	182, 325
Total.....	2, 008, 880

REFORMING ANCIENT WATER CONTRACTS.

The free perpetual water rights under the Pallavicino system hampered the association in its efforts to systematize the delivery of water. Through the purchase of these canals the association took over the obligation to supply 85 ancient rights with free water. Each of these rights supplied a considerable number of farmers. As a rule, the right called for the water which would flow through a certain gate, but these gates were, many of them, put in when hydraulic principles were not well understood, and this and subsequent changes in the canal had greatly increased the quantity flowing through them. One gate which was intended to deliver 4 oncias actually delivered 50 oncias.^a Many other gates were in a position to take much more than the number of oncias originally contracted for. The total nominal quantity required to supply these free rights was 355 cubic feet per second. The actual amount taken was much more.

When the association undertook to correct these abuses the holders of the rights contested, claiming that these gates had been in this condition for so long a time that a prescriptive right had been established. It required considerable litigation before the association was given authority to remodel the gates, but this was finally accomplished. The agreements with those who paid a rental were not satisfactory, but fortunately these all expired in 1900 and advantage was taken of this to bring about a complete reorganization in the water charges. The free perpetual rights could claim only water from the Oglio. They had no claim on water from the Marzano, and the Oglio would not supply what was needed in dry years. The association had the right to fix the charge for any additional water from the Adda. Two arguments were used to convert the holders of the free rights. One was that if these free rights paid the regular rental for water from the Marzano, the charges for twelve years would not equal the injury caused by the drought of a single year. Hence it would pay them to abandon their free right to be sure of this protection. Furthermore, bringing all the gates under a single agreement would facilitate the distribution, lessen neighborhood friction, and put an end to what promised to be long and expensive litigation. The modification which was worked out was that the old free rights should pay 60 cents a liter per second per year for what was formerly free water and pay the regular rental on the additional

^a It was an orifice cut in a thin slab of stone and put in the ditch bank; the opening was 15.8 inches high, 1.57 inches broad, and with a pressure of 1.57 inches above the upper edge of the outlet. The ancient regulation was that none of these openings should pass more than 24 oncias. This would make an opening 15.8 inches high and 37.7 inches wide.

water supply from the Adda. Ten of the old gates now take water under these terms. For all others the contracts are made in accordance with the following rules:

RULES FOR THE RENTAL OF WATER FROM THE CREMONA IRRIGATION ASSOCIATION.

1. The distribution of water shall continue from April 25 to September 25 of each year.

2. Annual rental is divided into two equal parts—one due March 15 and the other due July 15 of each year—and is payable in Cremona to the cashier of the association, with a penalty of 5 per cent interest in case of delay, the association having always the rights and privileges of collection.

3. When a grantee, after a period of fifteen days, does not comply with any other provision of the contract, the association has the right to shut off the water by closing the diversion gate without releasing the grantee from the obligation to pay the entire annual rental as established in the agreement.

4. The administration of the association shall not dispose of more than 1,250 Cremonese oncias, equal to 25 cubic meters (875 cubic feet) of water per second, diverted from the Adda, granted in the concession obtained, and in proportion to this quantity whatever water is actually flowing in the canal shall be divided among the diverting gates.

5. There shall be no reduction in rentals on account of deficiency or interruption of water except as provided below:

When for not less than twenty consecutive days between May 15 and August 15, by natural causes, there is a deficiency of water or any interruption in the distribution of the quantity due the grantee a reduction shall be made exclusive of all other indemnities within the following limits:

If, at the diversion gate, the quantity of water flowing constantly is less than one-half that due the grantee, he shall have the right to repayment of one-fourth of the annual rental.

If during the whole period of twenty days the quantity of water is less than one-third of the amount due, one-half the rental shall be refunded.

The rental shall be paid in full, but in case of deficiency repayment shall be made after the determination of the conditions above indicated and after the end of the summer season.

In order to obtain a reduction in rental, the grantee must present a written notice of the shortage complained of to the representative of the association not later than fifteen days from the day when the deficiency begins, and if the deficiency continues, the written application for repayment of part of the rental shall be presented within seven days following the end of the period of twenty days. It is agreed that if this is not done there shall be no compensation in any case, either when the first notice is omitted or when the presentation of the demand within the time established is omitted.

In any action regarding a deficiency complained of it is established that the weekly hydrometric observations, sent by agents of the association to the president of the association in tables properly countersigned and kept in the archives of the office, shall be absolute proof.

6. The distribution of water shall be made by the water master of the association, and the keys of the gates shall remain exclusively in the hands of the administration of the association.

7. The expenses of construction and maintenance of gates for carrying out the contracts, as well as for the demolition of the same, shall be paid by the association, but the association shall be reimbursed for such expense by the lessee within eight days of receipt of notice of the same.

Special rules provide for the cases in which the association desires to substitute different kinds of gates in order to obtain a more precise distribution of water, and for this purpose the fullest power is granted the association.

8. The lessee may not for any reason change any gate, or the works, bed, or banks of the canal, or in any way change the course of the water.

9. The lessee may not impede the flow of water in the gates without giving notice to the association at Cremona at least two days in advance and providing everything necessary to avoid any damage from the changed course of the water.

10. The water master or head custodian is obliged, on application, to furnish the lists in accordance with which the water is distributed from the canal, and to cooperate in every way possible to oversee the diversions of water by the users of water from the canal.

11. The water master of the association shall see that the gates are regularly constructed, and, when necessary, execute the works necessary to their proper construction at the expense of the users.

12. For all the purposes of these rules the lessee acknowledges his legal residence in Cremona to be ———, and accepts the courts of that city as the place for all suits relating to these rules.

13. The expense for this document and for making one copy of same for the administration of the association is a charge upon the lessee.

Special rules regulate the distribution of water during the winter season, which extends from September 25 to March 5 of each year. It is assumed that the discharge of the Marzano during this season is 490 cubic feet per second. Whenever it falls below this there is a proportionate reduction in the volumes delivered to each lateral.

The water handled by the association in 1904 was as follows:

	Cubic feet per second.
Free rights on the old Pallavicino canals.....	355
Rental water from the Marzano Canal.....	400
Rental water from the Pallavicino Canal.....	212
Total	967

This leaves about 230 cubic feet per second of the association's right for which it has not as yet found a market.

The following is a schedule of rates adopted in 1905:

Schedule of rates for water distributed from the canals of the Cremona Association for 1905.

SUMMER WATER.

	Lire.
Directly from the Marzano Canal, for each liter per second....	23
From the Pallavicino canals, for each liter per second—	
To below the mill of Piadena.....	40
To below the Robecca road.....	37
From the Robecca road to the division gate at Mirabello..	34
All others.....	32

With the following conditions:

1. In all annual contracts for summer water definitely established after the month of May the rental shall be increased one-tenth.

2. The rental actually in force shall be maintained in case of renewal of a contract paying a rental higher than the rental given in this schedule.

3. When new ditches are added to the system of canals belonging to the association, the rental for these ditches shall be increased in proportion to the expense for their opening.

4. The private gates which are found along the Pallavicino canals below the crossing of the Marzano Canal may be taxed according to the rates for gates taking water from the Marzano, provided they do not make application and pay in advance the annual rental of 3 lire per liter provided for such gates.

5. The mixed gates (drawing some rental water and some owned) along the Pallavicino canals below the crossing of the Marzano, after the termination of the contracts now in force, shall receive their water in separate gates or increase the charges for the rental water by a sum corresponding to 3 lire for each liter (\$17.10 for each cubic foot per second) of the water owned.

WINTER WATER.

1. The rate for winter water for meadows, marcite, and for power, with the preference given to agricultural concessions, is 1 lire per liter per second.

2. The council has the right to reduce the rate to 70 centesimi per liter per second during the first three years of its use on new land when the contract runs from nine to twelve years and when the water is to be used on new marcite fields.

3. The rates in force shall be continued in the renewal of contracts in which the rates are higher than 1 lire per liter per second. When the quantity of winter water applied for in the renewal of a contract is greater than that contracted for in 1903-4, the council has the right to apply to the added quantity the rate of 1 lire per liter per second.

According to a previous decision of the assembly, the rates for winter water were as follows, per liter of water per second:

	Lire.
Directly from the Marzano Canal.....	2. 00
From the Pallavicino Canal above the discharge of the Mar- zано Canal	3. 00
All others.....	3. 00

4. The council, as regards the water rates, shall not consider as new the marcite fields in whole or in part composed of lands which in the past were cultivated as marcite meadow. In such cases the tariff already in force for marcite shall apply to the winter water for the new fields.

5. When the winter water serves for marcite and also for generating power the council has the power to fix the rates according to its own judgment; but in any case the rates shall not be higher than the rates for winter water plus 1 lire per liter per second.

6. For renewals of contracts for water for drinking or for making ice the rules governing contracts made in 1903-4 shall apply, both as to quantity of water and as to rates.

7. For new contracts for water for drinking or for making ice which are not renewals of existing contracts, the rates shall be 2 lire per liter per second, but no concessions shall be made for quantities less than 10 liters per second.

8. The rental of winter water within the limits of the quantity available shall be made according to the rules and regulations which the council shall consider advisable for the guarding of the interests of the association.

THE ORGANIZATION AND ADMINISTRATIVE REGULATIONS OF THE ASSOCIATION.

For administrative purposes the canals of the association have been divided into two divisions of sixteen districts.

The canal has the following officers: Superintendent of canals, who is a civil engineer; the secretary, who is also an engineer; the auditor, the application officer, and two inspectors.

The ditch tenders are under the merit system and live in houses built expressly for them by the association at points where the canals are most in need of watching. Formerly the work of repairing and cleaning out canals was let by contract to the ditch tenders, but this practice has now been abandoned as has been the former custom of leaving the maintenance of the canals to the water users. The ditch tenders of the association are made special police.

All the employees of the association are insured in the National Bank of Insurance against sickness and old age and are entitled to a pension at the age of 65 years. They are also insured by the association against accidents in their work.

Weekly reports are made showing daily water measurements, the amounts of money received and expended in the payment of wages of employees or other expenses connected with the work where immediate payment is necessary. All other payments are made directly from the office of the president.

The work of the ordinary maintenance of the canal is divided into four classes: (1) Cleaning canals, (2) repairing banks and structures, (3) building dams in the Oglio, and (4) the removal of plants or aquatic vegetation.

The canals are cleaned out between March 15 and April 25, which period, according to an ancient custom, separates summer and winter irrigation.

In 1902 the length of this period was reduced to ten days because of the need of water for power purposes. Cleaning is done by day's work, by laborers secured from place to place; at times these number several hundred. The repairs of the banks and structures also take place in the spring. Very little wood is now used. Masonry laid in lime, or brick laid in cement, or concrete blocks, are the rule. In protecting banks from erosion, either loose rock or bags made of galvanized-iron wire and filled with bowlders or willow brush weighted with concrete are used.

There are no permanent dams in the Oglio. When the river becomes low, either in summer or winter, temporary dams made of bowlders and sand collected in the streams of the vicinity are placed in the stream at the head of the canal. They are washed out in flood season and have to be reconstructed the next year.

One of the most important and expensive operations connected with

this canal system is the removal of aquatic vegetation which in summer grows in the canals to an enormous extent. It is necessary to clean some of the canals three or four times during the summer. This is done in different ways, according to the depth of the water, and in every case the work begins at the lower end and goes upstream. When the water is less than 4 feet deep, the grass is cut with a common scythe. When it is deeper than that, by a man standing on the bank and using a curved scythe with a long handle. On large canals like the Marzano the work is mainly done by dragging across the canal a specially formed grass cutter operated by means of ropes pulled by workmen on the banks.

Owing to the fact that this canal runs through an irrigated country, the land above it being irrigated as well as that below, the loss from seepage is light, not exceeding 10 per cent, the inflow from above about equaling the outflow below. Seepage losses have been reduced by lining the canal in places where the losses were greatest. The evaporation loss is about three-tenths of 1 per cent.

Telephone lines connect all branches of the system and greatly facilitate the distribution of water. For the last seven years (1899-1905) the average annual expense has been as follows:

Cleaning	\$3,300
Removing vegetation from the canals.....	1,000
Miscellaneous repairs, remodeling structures, building of dams in the Oglio, etc.....	4,860
Total.....	9,160

Before the supplemental supply from the Adda was obtained the fall of the canals had little value for power purposes because of the great variation in the flow, but with this supplemental supply the power which could be developed became an important source of revenue. The association in making contracts to use the fall in the canal for power purposes has always given preference to the municipalities. The most important points in these contracts are summarized as follows:

1. The association furnishes the power in the form of a three-phase current at high tension at the place of production, the communes providing for the construction and maintenance of the transmission lines from the plant to the places of use, the communal administrations being responsible for damages to the lines.

2. In cases of deficiency of power the association grants rebates on the rental in proportion to the quantity and to the time during which there is a deficiency, but no rebates are given:

(a) When there is a difference of only 3 per cent, as shown by the measuring apparatus at the power plant;

(b) For an interruption of one hour each day from 12 to 1 o'clock;

(c) In the period of cleaning the canals, ordinarily lasting ten days in each year. When this limit is exceeded, there is granted a proportional reduction in the rental, as for all extraordinary deficiencies.

3. There is no rebate on the rental when the power is available, but is not delivered on account of the request of those who should receive it or on account of waste in the line transmitting the power to the purchaser.

4. For having an automatic measurement daily during operation the association provides for placing in the power plants, at the expense of the users of the power, a measuring device (wattmeter or amperometer, registering automatically), which is also maintained at the expense of the user.

5. The user is obligated to connect by telephone, at its own expense, the power plant of the association with station receiving the electric power, in order that it can give to the association notice regarding any changes in the amount of power needed.

The price of power varies from a maximum of \$50 to a minimum of \$38 per kilowatt year. The average price is \$46 per kilowatt year (\$34.50 per horsepower per year).

Showing the importance of power as a factor in the operation of irrigation works, it is said that from the time of the beginning of operations—1902—to 1906 these power plants have sold 2,158,878 kilowatt hours. If all this power had been developed by engines, either gas or steam, it would have consumed 8,538 tons of coal, which would have cost \$70,000. This money would have been expended entirely outside of the district.

The canal system has a number of other power stations not yet developed, from which it expects to double the power revenue.

Financial record of the association.

The total gross annual income of the association has been:

	Lires.
For year ending Dec. 31, 1901	652, 125. 97=\$126, 860. 31
For year ending Dec. 31, 1902	556, 439. 89= 107, 392. 90
For year ending Dec. 31, 1903	600, 519. 78= 115, 900. 32
For year ending Dec. 31, 1904	^a 549, 462. 56= 106, 046. 27

These sums are made up as follows:

Receipts for years ending December 31, 1901-1904, in lires.

Sources.	1901.	1902.	1903.	1904.
Water rents collected in summer and winter	417, 442. 22	421, 175. 85	425, 776. 12	435, 539. 60
Income from real estate and sale of products		15, 080. 75	20, 229. 61	18, 716. 30
Income from sale of electric power		10, 735. 00	17, 493. 28	40, 379. 19
Leases, investments, interest, etc.		3, 733. 92	3, 682. 92	4, 135. 21
Contribution from 59 farmers' societies	30, 900. 00	30, 900. 00	30, 900. 00	30, 900. 00
From work done on special private accounts, etc.		4, 516. 40	1, 030. 62	4, 976. 37
Sale of real estate, etc.		3, 333. 70		2, 857. 45
Other receipts of a patrimonial character	19, 042. 71			
Reimbursement	7, 258. 79	1, 649. 28	3, 694. 16	
Rebates on taxes	57, 482. 25	44, 745. 05	44, 253. 18	
For foundations and construction of cantoniera house at Ticengo			21, 427. 97	
Fund to offset depreciation of machinery at power house			6, 000. 00	
Drawn from government and provincial subsidy to balance expenses	120, 000. 00	20, 569. 94	26, 031. 92	11, 958. 44
Total	652, 125. 97	556, 439. 89	600, 519. 78	^a 549, 462. 56
Equivalent to	\$126, 860. 31	\$107, 392. 90	\$115, 900. 32	\$106, 046. 27

^a The figures for 1904, as stated in letter from Engineer Valcarenghi, do not include sinking fund payment of 91,313.84 lires.

The total gross annual expenses of the association have been as follows :

Expenses for years ending December 31, 1901-1904, in liras.

Items.	1901.	1902.	1903.	1904.
Various fixed charges.....		10, 224. 65	10, 224. 35	10, 237. 39
Interest on loans from Bank of Risparmio.....		196, 562. 50	193, 534. 37	265, 346. 87
Fixed expenses, interest on loans and bonds, admin- istration, etc.....	499, 596. 25			
Paid People's Bank of Cremona.....		38, 824. 64	39, 109. 10	57, 535. 94
Interest on bonds and rebated taxes.....		74, 294. 03	74, 289. 53	74, 289. 53
Administration and maintenance of power house.....		46, 591. 37	54, 229. 58	78, 282. 09
Government imposts and taxes.....		48, 072. 12	47, 629. 54	5, 570. 35
Work on account of third district.....	7, 258. 79	1, 649. 28	3, 694. 16	
Various expenses.....		9, 952. 12	15, 559. 63	
Reconstruction, maintenance, and repairs on canal system.....	88, 786. 29	44, 057. 88	47, 394. 71	53, 224. 02
Special private account.....				4, 976. 37
Summary of expenses.....	595, 641. 33	471, 228. 59	485, 664. 97	<i>a</i> 549, 462. 56
Extraordinary expenses to adjust balance.....	42, 484. 64			
Paid into sinking fund.....		85, 211. 30	93, 426. 84	
Acquiring real estate and construction at Ticengo.....			21, 427. 97	
Extraordinary expenses.....	14, 000. 00			
Total gross expenses.....	652, 125. 97	556, 439. 89	600, 519. 78	<i>a</i> 549, 462. 56
Equivalent to.....	\$126, 860. 31	\$107, 392. 90	\$115, 900. 32	\$106, 046. 27

a The figures for 1904, as stated in letter from Engineer Valcarengghi, do not include a sinking-fund payment of 91,313.84 liras.

Amounts paid by association on sinking fund for use in retiring bonds and loans.

1902.....	\$16, 445. 78
1903.....	18, 031. 38
1904.....	17, 623. 57
1905.....	14, 475. 00
Total.....	66, 575. 73

The progress of the association toward the time when it will be unnecessary to draw upon the Government and provincial subsidy in order to balance its receipts and expenses is shown in the following table :

Amounts drawn from Government and provincial subsidy.

1901, actual.....	\$23, 160. 00
1902, actual.....	3, 970. 00
1903, actual.....	5, 024. 16
1904, actual.....	2, 307. 98
1905, estimated.....	00. 00
Total.....	34, 462. 14

THE NORTH VERONA WATER-USERS' ASSOCIATION—A DISTRICT WHICH FAILED AND THEN SUCCEEDED.

The history of irrigation on the beautiful plain west of Verona reads like the tribulation of a Wright irrigation district in California. The troubles were the same, the results much alike. Lack of money to complete the work, ruinous discounts on bonds sold, poor construction, and at the end a body of farmers not ready to adopt

irrigation. The story of the Wright districts which failed and those which succeeded was being duplicated in every essential detail at about the same time on the south bank of the Adige. As in the Modesto and Turlock districts in California, irrigation has finally proven its worth, but not in time to save its promoters. The story which follows is one of agriculture and finance. The canal is beautifully built, but with nothing novel in its structures.

HISTORY.

In 1806 Napoleon gave the landowners west of Verona a right to take water from the Adige for irrigation. No use was made of this for sixty-three years. Much of that time Verona was a fortified camp, one of the strongholds of Austrian rule. Abandoned fortifications still dot the irrigated territory. By 1879, however, the farmers were ready to make the most of peace. A district embracing 39,000 acres was organized to build a main canal 10 miles long, to carry 388 cubic feet per second, with 140 miles of distributaries, to cost \$568,000, or about \$14.60 an acre. A contract was let for this work in 1880. When it was about half completed, the firm which had bought the bonds failed, and the association had to borrow money at a heavy discount. Next it was found that the estimated cost was far too low, and another loan of \$956,000 had to be made, and this, with accumulated interest, made the cost of the completed canal \$1,737,000, or about \$45 an acre.

The Government came to the relief of the company with a subsidy of an annual payment of 3 per cent interest on the estimated cost, to run for ten years. This amounts to nearly \$20,000 a year, but it was only a drop in the river of interest and other charges which overwhelmed the association. About 1 liter per second per hectare (1 cubic foot per second to 70 acres) is used in irrigation. Under the original estimate of cost water could have been furnished for a yearly charge of \$131 a cubic foot per second, but the actual cost raised this to \$262 a year. This is an excessive charge for water anywhere in northern Italy.^a It was ruinous in this district, for the soil is not rich, being thin and sandy in the best sections and so gravelly in others as to be worthless for irrigation. So much of the land proved to be of this character that the watered territory finally shrunk to 24,000 acres, then chiefly used for growing mulberry trees and wheat.

In 1894 the district was bankrupt. The annual charge for water was \$6 an acre. Farmers who wished to irrigate had to level the ground, pick stone, and build laterals. They had to change from wheat farming to meadows and dairying, and this required stables.

^a Compare with prices under Ritorto and Marzano, pp. 16, 34.

hay lofts, and more houses for laborers. The average cost of these improvements was \$60 an acre. Interest on this at 6 per cent was \$3.60 a year. This, taken with the \$6 charge for water, made it necessary for a farmer to make \$10 an acre a year more off irrigated land than he did off unirrigated. They are doing it now, but at first tenants would not pay the extra rent. Unirrigated land rented for \$1.40 to \$2.60 a year. The most tenants would pay for irrigated land was \$8.40 a year. Every acre irrigated meant a loss to the owner of \$3 a year. The rent did little more than pay the water tax, leaving the landowner no income from his highly improved land. The result was that landowners were threatened with being taxed out of existence.

A report on the financial condition of the district made in 1894 for the purpose of showing the need of some compromise with the bondholders contained the following statement:

No doubt it would be to the interest of many to abandon their lands, and as these lands would not be bought by anybody they would remain the property of the association.

We have already had an example of lands not rented because of the high charges of the association. We have recently seen examples in the expropriation of land (sale of land for taxes) where there were purchasers and competitors for the lands not included in the association, *while no purchasers were to be found* at the lowest price of 60 times the State tax *for the lands included in the association*. If we had not a natural discretion we could tell the names and places of the proprietors. Without some adequate remedy the same thing will happen to the lands belonging to most of the members.

The irrigation of the North Verona lands is the cause of the much lower value of the lands; also the lack of purchasers and the fact that neither capitalists nor the banks will loan money on these lands. If the charges for water be raised the greater part of the lands belonging to the members will pass to the association and it will then be in the same condition as the members. The persons will be changed, but not the conditions and not the consequences.

This reads much like the report of many Wright irrigation districts about ten years ago. Fortunately, the gloomy forebodings were not realized. Better times were ahead. The lands when brought under irrigation increased in production, tenants found they could pay higher rents, and in time the association was able to meet its payments and irrigation instead of destroying land values so increased them as to become highly popular.

At the time of my visit the association had a large and attractive business office in the palace of the Canossa, and had applied to the Government for an additional appropriation of 1,400 cubic feet of water per second to be used for extending irrigation and developing power. The farmers were prosperous. The two scenes in the district shown in Plate III show the excellence of the canals and the well-kept fields.

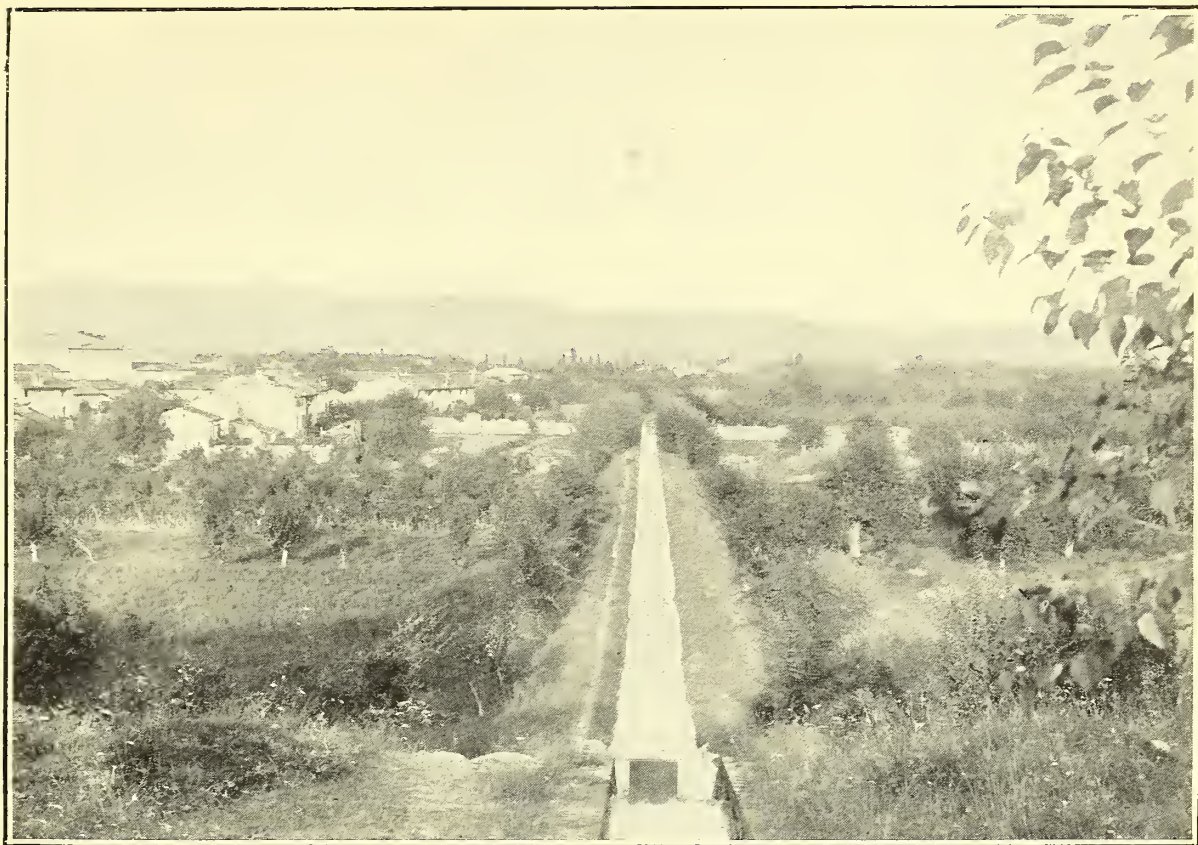
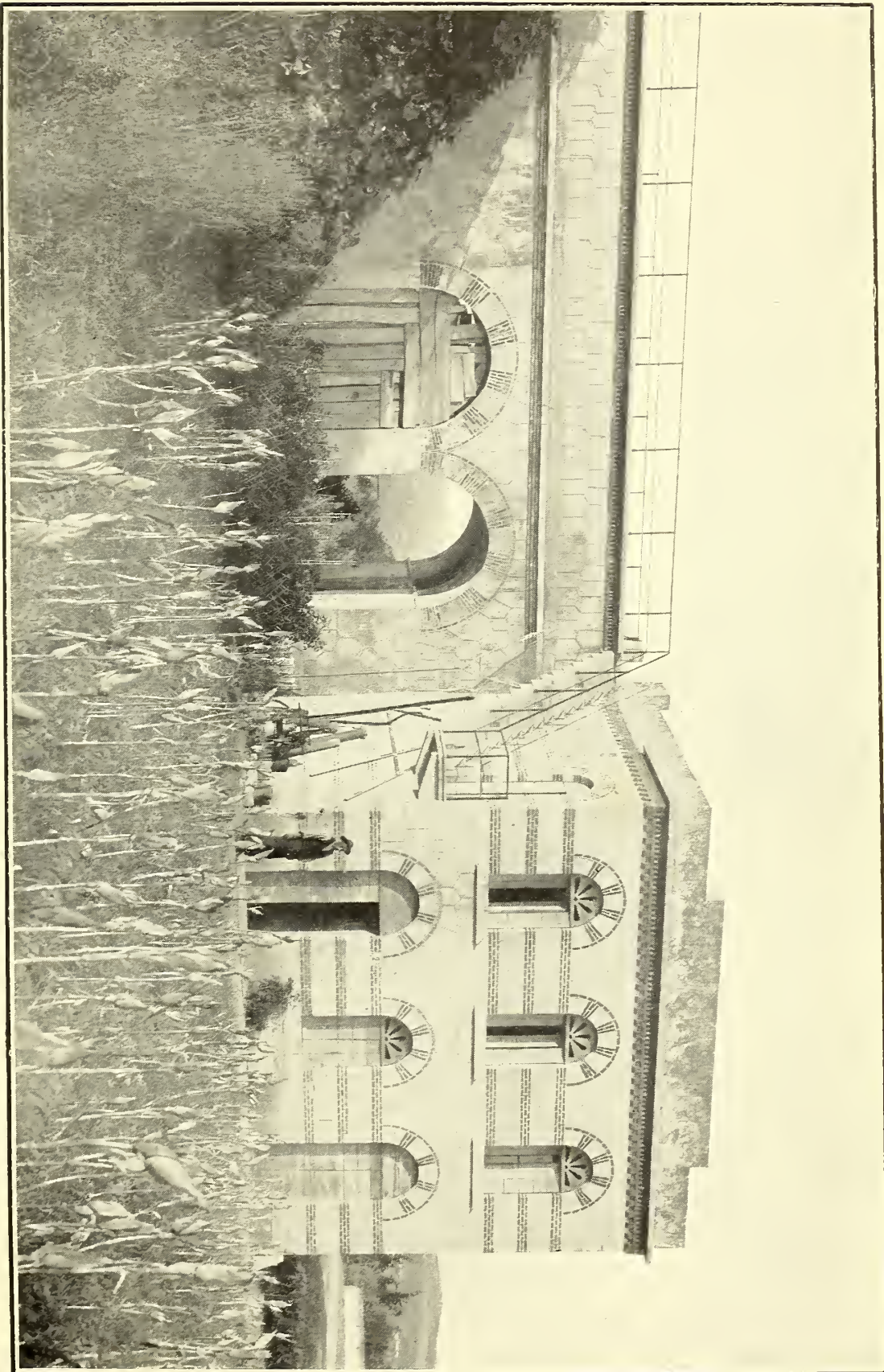


FIG. 1.—LATERAL FROM THE VERONA CANAL, PASSING THROUGH A FARM VILLAGE.



FIG. 2.—VERONA CANAL PASSING UNDER A ROAD BY AN INVERTED SIPHON.



POWER HOUSE UNDER VERONA CANAL.

THE DISTRIBUTION OF WATER TO IRRIGATORS.

The association operates the main canal. Branch associations of farmers operate the laterals. A constant supply is delivered to each lateral and the use of this is rotated. Water is measured through trapezoidal weirs, which vary in length with the volume delivered. Up to a delivery of 14 cubic feet per second they are all 1 meter long. The rotation period under the laterals is one hundred and seventy hours. At the beginning of the season each farmer is given a card which shows the first time he will be entitled to water, and after that he keeps his own account of the time and raises and closes his own gate. The length of time each farmer is entitled to use the water depends on the volume he has contracted for, his period of use having the same proportion to the one hundred and seventy hours that his volume bears to the total volume carried by the lateral; that is, if C is the volume of water a farmer is entitled to have, Q the volume the lateral carries, H the hours the farmer will have water on his field, R the rotation period in hours, H is found by the following formula: $H = \frac{CR}{Q}$. Thus a lateral carrying 243 liters would

be used forty-two minutes by a farmer entitled to 1 liter. If he was entitled to 2 liters, he would use it eighty-four minutes. If the lateral carried 170 liters, then a farmer entitled to 1 liter would have the use of all the water for one hour in the one hundred and seventy.

The duty of water under different laterals varies widely. Owing to the difference in the character of the soil, people under different laterals are entitled to buy whatever they are willing to pay for, the charge being made by volume. The books of the association showed that the community of San Massimo purchased 9 cubic feet per second for 3,886 acres, a duty of 432 acres for each cubic foot per second. Another community buys 5.48 cubic feet per second for 1,869 acres, a duty of 341 acres per cubic foot per second. A third buys 6 cubic feet per second for 1,889 acres, or a duty of 315 acres per cubic foot per second. The volumes contracted for by the different consumers vary from 9.45 cubic feet to 0.018 cubic foot per second. Altogether, there are a thousand farmers buying water from the canal. To maintain and operate the main canal requires 24 people, as follows: 1 chief engineer, 2 water masters, 2 assistants, 1 man for a pumping station near Verona, 12 campari or under water masters, 3 other men at points where they are needed. In the offices there are a secretary, a clerk, and a porter.

Since irrigation has become profitable, the association has made use of a drop where one of the laterals leaves the main canal, to lift 9.45 cubic feet per second 23 feet high. Plate IV shows this pumping station. The water pumped irrigates 494 acres above the canal.

DRAINAGE.

Verona marks approximately the line where irrigation gives way in importance to drainage. West of Verona irrigation is paramount; east of it, drainage. The north Verona lands association reaches down into the territory where drainage is essential and where the danger from seepage water was serious. Permission to build the canal was made conditional on the building of an intercepting drainage ditch which should follow the lower border of the irrigated land. This ditch, which is a seepage collector, is $22\frac{1}{2}$ miles long. It is built large enough to carry 17.65 cubic feet per second at the upper end, and 353 cubic feet per second at the lower end, or approximately the whole volume diverted by the canal. In its course it has several falls with a total drop of 69.4 feet. It has not been entirely satisfactory and the farmers below complain that they have been injured by seepage.

CONSTITUTION AND BY-LAWS OF THE VERONA IRRIGATION ASSOCIATION.

The by-laws of this association contain 88 sections and deal with practically every question which can arise in the management of an irrigation property. Many of the by-laws deal simply with routine matters, but there are some which relate to troublesome questions in the organization and management of districts in this country. These are given below:

CHAPTER I.—ORIGIN, CONSTITUTION, AND PURPOSE OF THE ASSOCIATION.

ART. 1. An association for irrigation is organized among the owners of land in northern Verona, called also the Verona Campagna, included within the boundaries of the project of Engineer Peretti, who have adopted this constitution.

The association has its origin in a concession of water from the Adige made by Emperor Napoleon I by the decree of July 25, 1806, and is regulated by the law of May 25, 1873, No. 1387, series 2, and by all other regulations in force in the premises.

2. The association is known as the Association for the Irrigation of Veronese Lands, and has its headquarters in Verona.

3. The purpose of the association is the irrigation, from April 15 to the end of September, of as large a part as possible of the lands included within the boundaries stated in the plan of Engineer Peretti, and map attached to the applications presented to the royal prefecture of Verona by the legal representatives of the Verona lands on October 20, 1878, under the number 502; a copy of which maps and plan shall remain deposited in the files of the association.

The association proposes to realize its object by the diversion of 11.5 cubic meters of water per second from the right bank of the Adige below Gajun, to be distributed among members, returning later to the Adige the water exceeding the needs of irrigation through a drainage canal which shall discharge near and below San Giovanni Lupatoto, according to the plan and maps above mentioned.

4. The boundaries of the association include, some entirely and others in part, the following communities: * * * having a total area of 15,600 hectares.

5. The diversion works and those to convey and distribute the water shall be constructed in accordance with the above-mentioned Peretti plan, subject to such changes as shall be ordered by the ministry and as the council of representatives shall consider necessary to adopt for the best interests of the association.

6. Expenses for construction shall be paid by one or more credit operations to be repaid by means of contributions from the members for a certain number of years, for the securing of the sinking fund and the payment of the interest.

7. The association shall be legally organized upon the signing of the statutory act of the society, prescribed by article 675 of the civil code. This signing shall be done after owners who have accepted the present constitution represent a distribution of water from the Adige of 8 cubic meters per second.

After this the legal representatives of the Veronese lands shall call the members in a general assembly for the election of a council of representatives, when their duties shall cease.

CHAPTER II.—RIGHTS AND OBLIGATIONS OF USERS.

8. The character of member and the right to use association water, except as provided in the following article 11, are acquired by signing the constitution of the society.

The constitution of the society shall be transcribed in the royal depository of mortgages, with an exact indication for each member of the lands submitted to the association with the respective quantities of water required.

While the right for the land originally submitted to the association remains in force, each member has the right to the use of his water for the benefit of other lands belonging to himself or to others. In either case the member shall have the right to lease, as far as possible, the water in the association canal at his own risk and expense.

9. The lands declared by each member in the constitution of the association shall be included in the association assessment roll, and are responsible for the payment of their respective shares of the sinking fund of the general debt, which shall be incurred for the construction of the work and for the annual tax for ordinary administration.

10. Members who shall wish to substitute, within the boundaries of the association, other lands belonging to themselves or to others, for those originally inscribed in the association, shall make application to the administrative council, attaching to it the documents showing possession.

If the council considers that the land proposed is not of less value than the first, and can be irrigated without damage to couses or to the association, it shall allow the requested substitution, and, at the expense of the member, shall provide for the corresponding change in the assessment roll and transcription in the royal depository of mortgages, releasing the lands previously assessed.

11. Notwithstanding the organization of the association, the administrative council shall have the power, before the distribution of the water begins, to exclude those lands which, because of difficulties or local conditions, shall make the conveyance of water too expensive; but the members may substitute other land that can be irrigated. It also has the power to limit the quantity of water applied for, the maximum amount being fixed at $1\frac{1}{2}$ liters per second per hectare and the minimum at 1 liter per second per hectare.

Lands excluded from the benefit of irrigation shall be withdrawn from the assessment roll and the respective volumes of water shall be reapportioned, all at the care and expense of the association.

12. The water shall be conveyed to every member to the boundary of the lands for which he has requested irrigation, and to a convenient place for the irrigation of the land,

13. No member shall be obliged to pay any share or tax to the association before January 15, 1889.

14. The plan for gradual reimbursement of the debt that shall be incurred for the construction of works shall not be for capital and interest a greater annual charge to each member for the first ten years than 37 lire per liter; for the second ten years, 41 lire per liter; thereafter, 44 lire per liter for the least number of years possible.

15. Each member shall have the right to pay at one time his debt for the purchase of water, so that afterwards his payments shall be confined to the taxes for ordinary administration.

Members who shall desire to exercise this right shall make application to the council of administration within the term provided by the said council, so that it can take this into consideration in its financial operations and in forming the general plan for reimbursement of the cost of construction, and the council shall have the right to fix the time for releasing these lands from the obligations of the association.

16. The liability of members is extended to all the general expenses of the association, which shall be divided proportionately to the respective amounts of water requested. General expenses are all those incurred in making the plan and obtaining approval, those for the organization of the association, for the confirmation of the cessions of water, and, later, for the construction of works in accordance with article 5.

17. After the first year of irrigation the maintenance of the distributing canals, which are those which, by means of gates, convey water to the boundaries of the lands to be irrigated, shall be under the charge of the respective users.

18. The collection of payments to the sinking fund and of the annual tax for the administration shall be made under the formalities and with privileges of the law for the collection of land taxes; thereafter the association shall have the power of collecting in accordance with the law of May 25, 1873, No. 1387, Series II.

19. Among the members there is no joint liability. Each is responsible only for the payment of a share corresponding to his amount of water and for the annual tax for ordinary administration.

20. The association council shall make the plan for distribution of water by continuous flow or in rotation to individual users.

Possible protests against the plan of distribution shall be referred to the judgment of three members of the arbitration board provided for in article 47.

21. Special regulations to be made by the council of administration and to be approved by the council of delegates shall provide for the distribution of water by continuous flow or by rotation in accordance with the plan provided for in the preceding article; for the maintenance of canals and corresponding structures, either association or private, in accordance with article 17; for the policing and supervision of the same; for the list of technical and administrative employees, with their duties, and for whatever may be necessary for the perfect execution of the present constitution.

CHAPTER III.—REPRESENTATION AND ADMINISTRATION OF THE ASSOCIATION.

22. The representation and administration of the association is committed—

- (a) To the general assembly of members;
- (b) To the council of delegates;
- (c) To the council of administration.

CHAPTER IV.—THE GENERAL ASSEMBLY.

23. Each member may be present at the general assembly and shall have the right to vote according to his interest in the association. In order to vote, it is necessary to have purchased at least 1 liter of water per second. Members inscribed for a less quantity of water than 1 liter may be represented in the general assembly by one of their number, provided the joint amount of water equals at least 1 liter. Coowners whose property is determined shall have a vote corresponding to their respective cointerest in the coownership. If coownership is not determined, their interest shall be presumed to be equal.

24. Minors, those who can not legally act, firms which have failed, and all those who have not the free administration of their property shall be represented in the assembly by their legal representatives. Corporations shall be represented by their administrators.

25. Everyone who has the right to vote in the assembly may be represented by a proxy whose authorization shall be countersigned by a notary or by a municipal official. No proxy can represent more than 500 liters besides those which he may own himself.

26. The general assembly controls exclusively—

- (a) The election of the council of delegates;
- (b) Changes in the boundaries of the association;
- (c) The approval of the construction of works for carrying out the plan in cases coming under the provisions of the following article 42.
- (d) The approval of possible changes in the present constitution;
- (e) All other acts also within the power of the council of delegates or of the council of administration on which the council of delegates shall think it necessary to have the vote of the general assembly.

27. The assembly shall meet ordinarily once every three years, in the month of March, for the election of half the members of the council of delegates, and extraordinarily whenever it is called by the council of delegates, and also on the written application of members whose total amount of water represents at least 10 per cent of the interests of the association.

28. The assembly, when called by the council of administration, shall be presided over by the president of the said council, or, in case of his absence, by the vice-president. The calls, either ordinary or extraordinary, are made by means of a notice to be published at least ten days in advance in all of the administrative communities of the association, stating the day and hour of the meeting and the business to be transacted, and by means of a notice in the newspapers of the cities.

29. The election of members of the council of delegates shall be by secret ballot, a majority vote being necessary, in accordance with article 678 of the civil code. Other decisions shall also require a majority vote and shall be made by roll call, except in cases concerning persons, which shall always be by secret ballot.

A majority vote shall consist of a majority of the votes, representing also a majority of the interests constituting the object of the association. The boxes shall remain open during two days (consecutive) during the office hours of the association and shall be closed during the intervals.

30. The decisions of the assembly shall be kept in a special record, to be signed by the president, by the oldest member present, and by the secretary; every record shall be posted in the association office.

31. Each member has the right to inspect and make a copy of the minutes of the meetings, in accordance with the provisions of the regulations.

CHAPTER V.—COUNCIL OF DELEGATES.

32. By the assembly shall be elected, in accordance with articles 7, 26, and 27, the council of delegates, consisting of 30 members elected from among the members, 18 of whom shall be chosen from among the 100 having the greatest interests.

33. Officials of the Government who must inspect the association administration, employees of the association, women, illiterate persons, or those who have any controversy with the association are not eligible as members of the council of delegates; but a husband may be elected for his wife, except in a case of legal separation already made by the courts, and fathers for their minor sons. Persons already elected shall cease to be members of the council of delegates when they have not the free administration of their property; when they have been condemned for financial offenses; when they have failed; or are collectors of the association. Parents and descendants, brothers, fathers-in-law, and sons-in-law can not be at the same time members of the council.

34. The office of a councilor is personal, and he can not be represented by a proxy, nor can he send his vote in writing.

35. The councilors remain in office six years. One-half are elected every three years and may be reelected. At the beginning the terms of office shall be determined by lot.

36. In case of a tie vote the elder shall be chosen.

One who succeeds a councilor having an unexpired term shall hold office for the balance of the unexpired term.

37. Every three years the council shall select from among its members, by a majority vote, a president, who shall ex officio be president also of the council of administration.

The council of delegates shall select from among the members of the council of administration one who shall act for the president in his absence.

38. Vacancies in the council of delegates shall not be filled unless the council is reduced to less than 21 members.

39. The council of delegates meets ordinarily twice a year—in April, for the examination and approval of the accounts of the preceding year; in November, for the examination and approval of the budget for the succeeding year.

It shall meet extraordinarily whenever called by the council of administration, when the Government requests it, or request is made in writing by at least 5 councilors.

40. Calls, either ordinary or extraordinary, of the council of delegates, are made by the council of administration by a written notice to be sent at least three days before the meeting to the residences of the councilors, the said notice to state the place, day, and hour of the meeting and the business to be transacted.

Documents relative to business to be discussed shall be deposited at the office of the association the day preceding the meeting, during office hours.

All balloting shall require a majority vote and shall be in the form of a rising vote, or, if requested by three councilors, by roll call, and if a person is concerned, the balloting shall be secret.

To be valid, a meeting shall be attended by at least 16 councilors, of whom 4 are members of the council of administration. For a second session, it shall be sufficient if there are present, besides the 4 members of the administration council, 6 other members of the council of delegates. The business transacted shall be reported in appropriate minutes, to be signed by the president, by the

oldest councilor, and by the secretary, and posted in the office of the association. Any member may make a copy of this record in accordance with the rules provided in the regulations.

41. The council of delegates—

(a) Elects from among its members the members of the council of administration, by a majority vote.

(b) Decides upon the time and methods of constructing the works contemplated in the plan of Engineer Peretti.

(c) Provides the means for meeting the expenses, with power to bind the whole association in operations of credit, to be repaid gradually in a series of years.

(d) Provides the measures and manners of contracting for the association collections.

(e) Provides for the appointment and dismissal of employees of the association and fixes salaries and wages.

(f) Inspects and approves the budgets prepared by the administration council.

(g) Approves the regulations of the association in accordance with article 31.

(h) Gives power to the council of administration to represent the association in courts.

(i) Provides for everything not reserved to the general assembly or which is not delegated to the council of administration.

42. The council of representatives can decide upon the construction of work if it does not involve the distribution of 10 cubic meters of water per second, if it is not contrary to the vote of the general assembly.

43. A councilor shall refrain from voting on matters involving his personal interests, controversies, and acts concerning himself or his relatives up to the third civil grade.

CHAPTER VI.—COUNCIL OF ADMINISTRATION.

44. The council of administration is composed of 7 members—the president of the council of representatives and 6 persons elected from among themselves by the council of delegates. One-half of the 6 councilors shall be chosen every three years and they may be reelected. In the beginning the choice shall be by lot and thereafter by seniority.

For the validity of the decisions of the council of administration shall be necessary the presence of a majority of the members composing it and a majority vote of those present.

45. The council of administration of the association has the following duties:

(a) To compile the regulations of the association to be submitted for the approval of the council of representatives.

(b) The power to dismiss from the employ of the association employees and other dependents and to employ temporarily in extraordinary cases of necessity other persons, reporting such action in either case to the council of delegates at its first meeting.

(c) To provide for the regular operation of the administration and for the defense of the interests and rights of the association from every point of view.

(d) To provide that before the ordinary sessions of the council of delegates the budgets shall be regularly prepared.

(e) To execute the measures approved by the general assembly and the council of delegates.

(f) Enter into contracts for the construction of approved works, with the lowest bidders, in accordance with the conditions provided by the votes of the

council of delegates; enter into contracts with the lowest bidders for the association collections in accordance with the regulations approved by the council of representatives pursuant to the regulations in force for the collection of public taxes.

(g) To provide that after inspection of the works provided for in the plan there shall be made a map and a description of the canal, structures, gates, sluices, and whatever else belongs to the association, so as to secure their safe-keeping and to render more clear and easy the application of the regulations.

(h) To compile the list of contributions and of the annual taxes, and provide receipt books therefor with stubs.

(i) To provide for the payment of the sums stated in the passive part of the budget and the issuance of the orders therefor, with the signatures of the president or vice-president, a councilor of administration, and the secretary.

(l) Has the supervision of employees and dependents; the care of the necessary registration and the keeping up to date of the association assessment roll; provides, at the expense of those delinquent, a register giving the inscription of changes of ownership when such changes have not been reported within the legal time limit; shall also make changes in the association assessment roll when they have not been requested and care for the collection of taxes and fines in the manner prescribed for government taxes; shall also institute proceedings against transgressors of the regulations.

(m) To represent the association in suits or other matters through the president or vice-president, who has been authorized to go into the courts for the defense of the rights of the association.

(n) To make all regulations and provide all remedies that they consider necessary for the regular operation of the establishment that are not included within the duties of the council of delegates.

46. The election of substitutes for members of the council of administration who for any reason have ceased to be members shall take place at the next following meeting of the council of delegates.

CHAPTER VII.—SETTLEMENT OF CONTROVERSIES.

47. Controversies between members or between members and the association are settled by means of three arbitrators, whose decisions shall go into effect immediately, notwithstanding appeals to the ordinary tribunal, which shall always be permitted.

48. The council of delegates shall appoint a board of seven arbitrators, chosen from among persons not belonging to the association who shall be expert engineers.

From this board shall be chosen for each case, by the council of administration, three arbitrators, two of whom may be rejected by the other party to the controversy, in which case the said council shall substitute others.

49. The board of arbitrators shall have its headquarters in Verona in the office of the association; the individual members retain office for five years, and may be reelected.

In case of the death or resignation of an arbitrator during his incumbency of office the council of representatives shall proceed to appoint his successor, who shall hold office for the unexpired term of the member whom he succeeds.

50. The arbitrators decide without legal procedure in accordance with the rules of equity.

REGULATIONS FOR THE EXECUTION OF THE CONSTITUTION OF THE IRRIGATION ASSOCIATION OF VERONESE LANDS.

PART I.—REGULATIONS FOR THE DISTRIBUTION OF WATER.

ART. 1. Summer irrigation of lands begins at midnight of April 15 of each year and continues to the end of September. Winter irrigation begins soon after the last rotation of summer irrigation and ends at midnight of April 15 following. The council of administration shall announce each year the rotation of irrigation, both summer and winter.

2. Distribution of water to individual members is made in accordance with the plan of distribution prepared in accordance with article 20 of the constitution, which is filed at the technical office of the association and is kept up to date in connection with the association assessment roll. Any member may inspect the said plan during office hours.

3. Requests for changes in the plan of distribution shall be by members of the association to the council of administration in writing. The council of administration, when the changes requested will not damage couses or the association, after asking the advice of the technical office, may grant the applications. In case an application shall be refused the member has the right, within thirty days after announcement of the decision, to appeal to the council of delegates, their decision being final as an administrative authority; against it the members can appeal to the courts within thirty days from the time they receive notice of the decision of the council of delegates.

4. All necessary expenses in order that requested and granted changes may go into effect are at the sole charge of the applicants, who shall be obliged to deposit with the collector of the association in advance the amount of the said expenses, which shall be adjudged by the council of administration and by the council of delegates. If this deposit is not made within ten days from the date of the notice that shall be given by the secretary, this shall be taken to mean that the applicant has abandoned the change, and same shall not be executed without a new application and vote, which shall always be made within the time prescribed by the regulations.

5. In voting upon applications for changes or for other reasons, when applications are made by several parties at the same time and for technical or other reasons can not be granted to all applicants, the vote shall be taken with respect to the best interests of the association and of the said applicants.

6. A member has the power, in accordance with article 10 of the constitution, to cede entirely or in part the water by him subscribed, substituting for lands inscribed other lands owned by himself or others, included within the boundaries of the association. Applications for the substitution of lands shall be presented to the council of administration and shall follow the procedure established in articles 3, 4, and 5 of these regulations. Said applications shall be signed by both parties to the cession and shall be accompanied by the necessary documents in order to prove that the land to be substituted conforms to all the conditions imposed by the association in accordance with articles 9 and 10 of the constitution.

7. Each member has the right to ask changes in the use of water from one tract of land to another or from one gate to another. These applications, if their granting will not damage other users or the association, shall be granted. Presentation of this application as per sample attached to these regulations must be made within January of the year involved. After that time any changes

requested for that year shall be refused. These applications shall also follow the provisions of articles 3, 4, and 5 of the present regulations and shall be renewed each year within the above-mentioned preemptory period.

8. In accordance with the plan of distribution provided for in article 2 of the regulations, every year there shall be established by the council of administration the volume to be carried by each distributing canal, so that when it carries its normal flow it will be possible to use the water to good advantage. In accordance with this plan, the technical office of the association shall appoint the hours for the distribution of water to the individual users during the entire irrigation period. The schedule therefor shall be posted in the office of the association in Verona from March 1 to 15 of each year, where every user may inspect it. Any protest against the schedule shall be presented to the council of administration before the 20th day of the said March. After that date no protest of any kind shall be admitted. The provisions of the preceding articles 3, 4, and 5 shall be followed in the consideration of these claims. The schedule for the distribution of water approved by the council of administration shall be made known to the users by means of a notice signed by the engineer of the association. All schedules shall be posted in the office of the association, in the office of the engineer, and in the office of the guardians of the respective sections. In the cases of lands belonging to more than one owner, notices showing all the owners shall be given to that one among them who owns the portion of land at the point where the water is delivered.

9. Water is delivered to individual users in accordance with their rights to the gates constructed for this purpose by the association along the distributing canals, known as catasto gates; but, exceptionally and temporarily and when no damage will be done to co-users or the association, the opening of all gates known as private gates shall be permitted. Their construction shall be carried on under the supervision of the technical office of the association and shall be at the exclusive expense of the grantees. They shall be obliged to make, within ten days from the notice of the concession, an advance deposit with the collector of the estimated cost, and final settlement shall be made after the construction of the work. If the deposit is not made within the time above prescribed, it shall be taken to mean that the concession has been abandoned.

10. The opening of such gates shall not be granted to those who have less than 5 liters of water. When the quotient obtained by dividing the number of liters that are inscribed in the assessment roll by the number of catasto gates and private gates granted by the association is less than 5 liters, new gates can not be opened. All private gates, either those already in existence or those to be opened hereafter, are considered as temporary concessions which may be recalled whenever the council of administration deems advisable; always taking into consideration rights previously acquired by regular agreement or by verbal authority. But for these last confirmation shall be asked within three months of the publication of these regulations.

11. Concessions for private gates shall be made in accordance with the schedule of rotation prepared for irrigation, considering the interest of the applicants and with the assent of the users below. But they shall not be issued after January 31 of the year in which the gates shall be opened for operation nor when the water to be distributed from these gates is less than the limits provided for in article 14; nor when there is not the consent of the majority of the users of the catasto gates on the same distributing canal below the place where the new private gates are to be opened.

12. To users who, by canals to be constructed without incurring great expense, can use water diverted from a gate already in existence shall not be granted the opening or the maintenance of a new gate.

13. Private gates that can not be used during the entire irrigation period on account of the rotation of agricultural crops or at the will of the users shall be kept closed by a wall during said period, at the expense of the user. The opening of the gate shall be at their expense also. Failure to use private gates during three consecutive irrigation periods, as well as neglect to maintain them or the corresponding sluices, shall give the association the right to require the removal of the granted gates and to restore the bank of the distributing canal as it was before, at the charge of the grantee. When within a period of thirty days after notice a user shall not remove the works, those works shall be removed by the association and the expense therefor shall be collected by the association collector.

14. The transfer of water temporarily is limited by the condition that on the land originally irrigated shall be used not less than one-half liter per hectare, and on that substituted shall be used a quantity not greater than 1.75 liters per hectare. In case of a transfer of all the water inscribed and used from a gate, this shall be closed by a wall, at the expense of the grantee, and kept closed while the transfer continues. The expense of reopening the gate shall be at the charge of the grantee.

15. The member who has been allowed to transfer water from one catasto gate to another, or to a private gate for the irrigation of lands belonging to the same owner, shall use the distributing canal which is best suited, taking into consideration the best interests of the association when two or more canals are available for the transfer.

16. In the cession of water with the substitution of lands the water is measured at the new point of delivery by the measuring weir of the corresponding distributing canal.

17. When a member, not having renewed annually the applications for changes, comes back to the original status in accordance with the plan of distribution, a reduction in price for percolation, from that paid at first, shall not be asked.

18. When the transfer of water is requested for the substitution of lands more remote from the Chievo division gate, the council of administration may decrease the quantity of percolation along the secondary canals.

19. The council of administration has the power always, without damage to users or the association, to cede the water at its disposal to those applying therefor; also to rent it, always on condition that it shall consider the best interests of the association. Contracts shall not be given for a quantity of water less than 3 liters for a new gate. To gates already in existence may be given any quantity of water.

20. All water running in the main canal and the secondary canals belongs to the association. That flowing in the distributing canals beyond the measuring weirs belongs to users. After the water is delivered by the measuring weir, all responsibility of the association ceases in regard to the irrigation of land, drainage of surplus waters, and seepage waters.

21. In the hour fixed by the schedule of rotation each user shall be obliged to receive the water for the land for which it is destined at the point of delivery.

22. A user who has, besides the delivering gate (catasto gate), other gates (private gates) below that on the same distributing canal, if below him there are no other users, may use the water without regard to the schedule of rotation established for each gate. This may also occur when an upper user obtains the consent of all lower users.

23. If a user does not wish to use the water for irrigation or if there is an abundance, he may convey it into the two drain canals of the association, either directly or through the canals of the next proprietor, after having

obtained his permission. This privilege is subject to application to the council of administration and shall follow the rules provided in articles 3, 4, and 5 of the regulations. The concession for such discharge may be granted when it does not damage other users or the association.

24. Upon notice given regularly twelve hours in advance to the respective guardians, the delivery of association water to a user may be suspended if the said water can be discharged into the drain canal or delivered to those who may desire to receive it on their lands, or if it is possible to suspend or diminish the distribution from the diverting canal.

25. It is prohibited to introduce into a drain canal rain water draining from lands. This canal can serve only to convey association waters.

26. The member who shall act in opposition to the above article and shall cause damage to the association or other persons, either in the canal or in the structures, shall be responsible for said damages, either for what he has done personally or what has been done by those under him.

27. Users of distributing canals shall be obliged to see that their sluices are in perfect order by April 15 of each year and shall maintain them.

28. No user of a distributing canal can put in operation the small diversion ditch along the said canal before the established hour, and as soon as the term of each irrigation period has passed he shall cease the operation of the small diversion ditch.

29. Every user of a distributing canal shall be obliged to provide, at his own responsibility, such a lock on the gate as he shall consider necessary, so that the gates will not be opened and no water waste through during the hours when water must flow in the canal for the benefit of others. He shall have the right during his period for irrigation to see that there is no theft of water to his damage, providing against this by such works as he shall deem necessary, but being careful to not damage association property.

30. To the user on each section of the distributing canal who shall first use the water for irrigation shall be given the key to the gates at the point of diversion, but he shall be obliged to place in operation the small diversion ditch at the beginning of each irrigation period.

31. It is prohibited to allow water to remain in the distributing canal of the association in such a way as to menace the security of the canal or its banks.

32. If during irrigation the water shall be diminished at the headgate to one-third of the normal discharge, the depth flowing over the crest of each weir shall be reduced proportionally. If the diminution falls below one-third, a special rotation schedule shall be put in force, at least until the following rotation period. No compensation shall be given members in case of reduction in the amount of water supplied.

33. In case of a break or other damage on the main canal or on the principal or secondary distributors which can not be repaired within twenty-four hours, compensation shall be made to the users for the loss of water by means of a temporary rotation schedule, so compiled that this loss shall be divided in the most just manner among all the users below the point of break or other damage or below the point of diversion of water.

34. In the case of a break or other damage to the distributing canal, the users damaged shall not have the right to any compensation for the hours of irrigation which they have lost.

PART II.—MAINTENANCE OF CANALS AND STRUCTURES AND OF ASSOCIATION LANDS.

35. The maintenance of canals and corresponding structures is under the care of the association.

36. Expenses necessary for the maintenance of the main canal and distributing canals are included in the general expenses of administration. Those necessary for the maintenance of secondary or distributing canals (exclusive of sluices and corresponding locks), to be estimated each year on the basis of the preceding five years, shall be apportioned among the users in accordance with the amount of water used by them. Those members who receive water directly from the main and secondary canals and those who assume the maintenance and the direct administration of the distributing canals through which they receive the water to which they are entitled in accordance with articles 42 and following, of these regulations, shall be relieved from the payment of these expenses. Any damage done to structures and distributing canals through winter irrigation shall be a charge upon the user or users and shall be divided among them in proportion to the respective amounts of water used for winter irrigation.

37. During the summer season, and especially in the months of June, July, and August, provision shall be made for the cutting of herbs and plants, the removal from canals of everything that will impede or obstruct the free flow of water into the canals; for small repairs of banks damaged by moles or by other means; for the closing of breaks and the prevention of the waste of water from the gates. In short, provision shall be made for all those works or operations which shall insure to the members the use of the water.

38. Ordinary and extraordinary maintenance of gates and attached locks of catasto gates and private gates shall be made at the care and expense of the respective users, and, in case they shall object to doing so, the necessary work shall be done under the supervision of the technical office of the association and the expenses therefor shall be assessed to the users, and collection shall be committed to the association collector.

39. New members for the first year of irrigation and those who have rented water shall not be held for the maintenance provided for in the preceding article; on the contrary, the same shall be at the charge of the association.

40. Ordinary and extraordinary maintenance of all private works of any kind that affect the bed, banks, or sides of the association canals shall be made by the technical office of the association; the above expenses shall be a charge against the proprietor of the work, and collection of the same shall be made by the association collector.

41. Expenses that shall be necessary for the modification or demolition of works or structures damaging canals and association structures and for restitution to the original condition shall be at the charge of the owner of the work to be modified or demolished, and the collection of the expenses therefor shall be committed to the association collector.

42. If all the users of distributing canals (tertiary) shall wish to assume direct charge of ordinary or extraordinary maintenance of the canal used by them, they shall make application to the council of administration, who shall fix the formalities for turning over the canal and its water.

43. The users from a canal turned over to them for direct maintenance, as provided above, shall be obliged to execute all the work provided for in the preceding article 38, under the supervision of the association guardians, and shall be obliged to follow those orders which shall be issued by the technical office of the association for the proper operation of the canal.

44. When the above-mentioned works shall be neglected or not properly executed, the association shall have the right to have them executed ex officio, charging the cost therefor, with a penalty of 10 per cent. to the users of the canal, committing the collection to the association collector; in case of repetition of the offense, the maintenance of the canal shall be resumed by the association in accordance with preceding articles.

45. The lands belonging to the association of which it is the owner by expropriation shall be under the care of the technical office.

46. The council of administration shall have the right to sell or rent association lands under the terms and conditions which shall best serve the interests of the association. Contracts of sale of association lands must have the approval of the council of delegates.

PART III.—POLICING OF THE WATER, CANALS, AND ASSOCIATION STRUCTURES.

47. For all canals, water, and structures belonging to the association, constructed either on lands belonging to the association or on lands on which there is a servitude for aqueducts, is prohibited any work or action that might modify the condition, form, dimensions, resistance, or convenience to the use of which are destined the canals, banks, embankments, slopes, and their appurtenances and structures.

48. The following are expressly forbidden:

(a) Swimming or bathing in the canals.

(b) The pasturing of animals along the banks, slopes, etc., and the swimming of ducks, geese, etc., in the canals.

(c) Allowing animals to drink from the canals or to swim through same or cross on the dry beds.

(d) Passing along the banks and sides of association canals afoot or otherwise; the construction of bridges or foot bridges, rafts, etc., on association canals.

(e) The washing of clothes, utensils, or anything else in the waters of the association.

(f) The making of landing places for the loading or unloading of materials or products for boats or rafts; the making of level or inclined banks to reach the waters of the association.

(g) The removal of water by buckets and casks or pumps.

(h) The making of fixed or movable crossings or the throwing into the canals of branches and trunks of trees, straw, herbs, and especially the grongo, and, in general, anything of whatever nature that could obstruct the free flowing of the water.

(i) The soaking of hemp or flax in the beds of the canals.

(k) The making of dams or works of any kind for fishing.

(l) The depositing of materials of any kind on the banks, embankments, slopes, or tops of banks, or the removal of materials belonging to the association.

(m) The removal of the leaves of the mulberry trees, the cutting of plants of whatever kind may exist along the banks, slopes, embankments, and accessories throughout the area of association lands; also the removal of herbs that grow on said association lands.

(n) The planting of trees or hedges on the banks or embankments of the canals at a distance less than that prescribed by law.

(o) The changing or modifying of the level of the water or the banks of association canals, either with or without banks, and corresponding structures.

(p) The touching or damaging of any mechanism regulating association water; the damaging in any manner of the regular course of association water.

(q) The removal in any way of the sluices, the making of openings in them, or damaging them; the leaving open of the gates or keeping closed the small diversion ditches out of the established periods; in short, the doing of anything for diverting water for the benefit of oneself or others.

(r) The closing or impeding by fences or otherwise of the free passage to guardians onto association properties and the towpaths of the canals.

(s) The construction of works of any kind, temporarily or permanently, upon the properties of the association.

49. Animals pastured or loose, goods for loading or unloading, materials or goods deposited, and, generally, all objects found in violation of the present regulations shall be taken at the time of the transgression and delivered to the mayor of the community in which the said transgression has occurred.

50. Transgressors can recover animals taken, within ten days from sequestration, by making a deposit with the association collector of 1 lire for each biped and 5 lire for each quadruped, and 50 lire for each offense. Final settlement shall be made after the final decision. When transgressors do not recover animals taken within the times and terms above prescribed, they shall be sold at public auction and the proceeds of the sale shall be applied to the payment of the expenses of custody and maintenance; also of indemnity for damages and for the fines imposed.

51. When the transgressor is not known, the proceeds of the sale of the animals and articles taken, above the expenses and fines provided for in the preceding article a year after the transgression, shall be put into a special fund for the assistance of old or ill guardians of the association.

52. Transgressors shall be admonished by the guardians of the association and by any agent of the public authority, who shall make a report in writing upon the matter, giving the day and the place where written, the full name and title of the agent and of the transgressor, the circumstances and the nature of the offense, and the animals or materials taken.

53. The fact of the transgression as ascertained by the guardian or agent of public authority is assumed at the trial until the contrary is proven.

54. Transgressions through failure to observe the present regulations or any other damage shall be punished or settled in the manner established by law and by the general and special regulations in force in matters concerning water.

55. In addition to the corporal and pecuniary punishments provided by the penal code and the regulations in force, for every contravention or crime shall be imposed a fine in proportion to the gravity of the offense, from 1 to 200 lire.

56. When a transgression is not included in and can not be punished according to the penal code and the regulations of the council of administration, the transgressor can be requested to settle with the association within the terms and limits provided in the preceding article.

57. In case of repetition of the offense the fine and settlement may be doubled.

58. The transgressor is also obliged to pay the costs of proceedings, maintenance of the animals and care of the objects taken, and the reimbursement of damages either to the association or private individuals, in accordance with the civil code.

59. Fathers or guardians are respectively responsible for damages committed by minor sons or wards.

60. If a transgressor does not present himself within the time named by the council of administration to pay the fine imposed and make settlement as mentioned in article 57, or shall not consent to the same, the transgression shall be treated according to the judicial procedure the same as all other transgressions; that is, it shall be brought before the proper judge, who shall proceed in accordance with the law and the present regulations.

61. Fines and settlements shall be divided equally between the association and the agent or guardian reporting the transgression.

62. After regular application in writing, the council of administration may grant permission for work or actions that without such permission would be transgressions according to the provisions of the preceding articles, under such conditions as they shall deem necessary.

63. All those who have previously obtained permission expressed or understood, as mentioned in the preceding article, shall be obliged to have it confirmed within three months from the publication of these regulations. After this time, whatever work or action has not been permitted shall be considered and reported as a transgression.

64. Those who are not satisfied with the provisions issued by the council of administration can appeal to the council of delegates in the manner and within the term prescribed by articles 3, 4, and 5 of the present regulations.

65. Notice of the orders and decisions of the council of administration or of that of delegates shall be served by the guardians of the association by delivering a copy at the residence of the interested party or of the transgressor, indicating the date of delivery and the person to whom delivery was made. Report of the service shall be made by the guardians, with a duplicate of the notice served.

PART IV.—ORGANIZATION AND REGULATION OF GUARDIANS.

66. To enforce the police regulations of the canals and for the regular operation of said canals there is organized a board of guardians.

67. The board of guardians is composed as follows:

- (a) Two hydraulic guardians.
- (b) One guardian for the head works.
- (c) One machinist.
- (d) Fourteen permanent guardians.
- (e) Five temporary guardians.

68. The appointment of guardians is committed to the council of delegates. To be appointed they must comply with the following regulations:

- (a) They must read and write.
- (b) Must have fulfilled the obligations of the military service.
- (c) Must be at least 21 years of age and not over 40.
- (d) Must be in good physical condition.
- (e) Must be of good moral character.

The hydraulic guardians must have had experience in geometrical measurements. The machinist must have a certificate showing him to have had experience in mechanical work.

69. The guardians and the machinist shall have no commercial relationship with the water users or with others interested in the association. They are under the immediate direction of the engineer inspector.

70. The salaries of the guardians and machinist are fixed at the time of appointment for each of them. The machinist, guardians, and assistants at the diverting gate shall be insured against accident at the expense of the association. In case of accident they can not ask a greater compensation than that given by the insuring society. The council of administration shall fix at the best place the residences of the guardians. The machinist shall live in the power house, and the guardians of the diverting works in the building attached to the structure.

71. Before entering the service they shall take the oath prescribed by the law and with the effect of the law.

72. Each guardian shall be provided at the expense of the association—

(a) With a hat bearing the inscription "Association of Veronese Lands" as a badge.

(b) With a book of the gates, showing the distribution granted, with the rights and rotation appertaining to each user.

(c) With a notebook to note the daily measurements and operations of the canals, and all other matters of interest.

(d) With an inventory, in which shall be noted all the property and tools of the association committed to their charge and for which they shall be responsible, less ordinary wear and tear.

During service they shall be obliged to wear distinctive hats and to have with them the above-mentioned books and a shovel.

73. The guardians shall devote themselves exclusively to the discharge of the duties ascribed to them and may not undertake other work interfering with the custody and maintenance of the canals, embankments, etc.

74. The hydraulic guardians are obliged to inspect continuously the canals and to keep a correct note of all their hydraulic measurements, and to report all changes in the canals or their appurtenances, reporting each week in writing to the engineer inspector.

75. The hydraulic guardians are obliged to do desk work which shall be committed to them by the engineer inspector, and shall see that their guardians accomplish their work. They shall make monthly reports in writing to the engineer inspector on the conduct of the guardians.

76. The guardians and machinists shall not be allowed to leave the section of canal committed to their supervision, nor their residence, without permission in writing from the engineer inspector; they must be always ready to obey his orders at any hour of the day or night. In cases of emergency or damage feared or already occurred, if immediate remedy is necessary, they shall be allowed to leave their residences, but they are obliged to make report at once to the engineer inspector.

77. In case of sickness, a guardian shall give immediate notice to the engineer inspector, and shall produce a medical certificate if the illness has continued more than three days; if it continues eight days longer a substitute shall be employed, recommended by the engineer inspector; if the illness shall last more than three months, so that he shall not be able to work, he shall be dismissed.

78. Guardians and the machinist, in the exercise of their duties, shall be obliged to see that—

(a) The passage along the banks of the canals shall always be free and open, and that water is flowing in the said canals.

(b) The diversion gates for users operate regularly every day in the manner prescribed in the book of the gates, keeping a daily record of what they observe in the notebook.

They shall see that the regulations for policing of the waters and canals written in the book of the gates are observed, as well as the special orders given by the engineer inspector or the technical office of the association.

79. If they discover any transgression of the above-mentioned regulations the guardians or machinist shall be obliged to make a special record, as is provided for in article 57 of the regulations. Reports of transgressions shall be sent within the shortest possible time, and always within twenty-four hours of their occurrence, to the engineer inspector, who, over his signature and with his recommendations, shall send it to the office of the association. The objects sequestrated, together with a copy of the record, shall be turned over to the mayor of the commune in which the transgression was committed, in accordance with articles 54 and 55 of the regulations, in order that he may proceed in accordance with the law and regulations on public waters.

80. The guardians and machinist must be courteous to every one.

81. Any guardian or machinist who violates any of the provisions contained in these regulations, is drunk or impolite to his superiors or any other person, is subject to punishment as follows:

(a) Admonitions.

(*b*) A fine from 2 to 10 lire.

(*c*) Reduction to half pay for fifteen days to one month, with the obligation to perform their duties as usual.

(*d*) Dismissal.

The admonitions and fines provided for in letters *a* and *b* shall be imposed by the engineer-inspector and shall always be followed by a report in writing by the said engineer-inspector to the council of administration. The punishment provided for in letter *c* shall be imposed by the above-mentioned council. The dismissal may be authorized by the council of administration, but in such case it shall be confirmed by the council of delegates.

82. Those who omit or delay to report transgressions of the regulations of the association shall be subject to the above-mentioned punishments, and when a transgression for the abuse or diversion of water is involved the provisions of letter *d* of the preceding article shall be applied directly. The guardians and machinist can not, under penalty of immediate dismissal, ask or accept fees or gifts from those who have direct or indirect interest in the association.

83. All admonitions or punishments and the gifts for their good service shall be noted in a special register.

The fines and reductions in salary shall be turned over to a special fund for the aid of old or sick association guardians, as provided in article 51 of the regulations.

PART V.—RECORDS AND CERTIFICATES OF THE ASSOCIATION AND CHANGES OF OWNERSHIP IN THE ASSESSMENT ROLL.

84. The association may give copies of the acts contained in its archives. The president and the council of administration may give to those who make application therefor certificates proving facts concerning the association.

85. These copies and certificates shall be written on taxed paper, and payment therefor shall be made in accordance with the attached tariff.

86. Every transfer of lands subject to association water, whether by agreement or by succession, must be reported within a period of three months of the date of the transfer to the office of the association for change in the names of proprietors and for the regular keeping of the association roll.

87. Changes in names of owners are subject to the payment provided in the attached tariff.

88. Any failure or delay in reporting transfers of lands in accordance with article 86 shall give the association the right to impose a fine of 5 lire upon those who have omitted or delayed such report.

THE ITALIAN WATER LAWS.

HISTORICAL.

The present water law of Italy dates from 1884. It was revised in 1886 and has been amplified and perfected in detail since then. It is, on the whole, the most complete, and in operation the most successful code of irrigation laws to be found in any country. Many of its provisions were taken from the water laws of Lombardy and Piedmont, and these in turn show the influence of the mingling of traditions, ideas, and habits which came through the successive conquests of northern Italy by different European countries. The germ

of these laws came from the civil law of Imperial Rome. Under the Roman Empire the use of water for irrigation and domestic purposes assumed large importance, and the principles governing water rights had been clearly defined. With the downfall of the Empire, Roman jurisprudence ceased to be a controlling force in northern Italy, but it retained its influence through the persistence of unwritten laws and customs until the rise of modern civilization. When this occurred, these became the controlling influence in the shaping of modern irrigation laws. This influence was helped by two circumstances: The first was the discovery in 1147 in a monastery at Amalphi of a copy of the Pandects, long supposed to have been destroyed. This was a codification of the civil law intended to be a compendium of all the general laws of the Empire. Its discovery was coincident with the beginning of many of the greatest existing irrigation works in northern Italy, and a knowledge of its principles became disseminated at the time when such knowledge began to have supreme practical importance. The second was a compilation of the unwritten irrigation laws and customs of the Republic of Milan, prepared under the direction of its chief in 1216, and preserved in the Ambrosian library of that city. This irrigation code embodied many of the principles which underlie modern irrigation law not only in Italy, but in those States in this country which have abrogated the riparian doctrine. These laws were based on the idea of public ownership of running water. They recognized the right to its diversion and made irrigation a public use, thus giving authority to condemn private property for the rights of way of ditches and canals. Those building canals had to regard the prior rights of other water users and in carrying out these works they were bound to compensate others for any damages inflicted, and not to injure other works of like character.

Whoever has the right to obtain water from springs or rivers, or in any other manner whatsoever, can carry it through the fields and farms of any individual, commune, or public corporation in this State, and also across the public roads.

To this end he can construct the canals or channels, and other necessary works, at the least possible inconvenience and injury to the proprietors of the farms, paying one-fourth more than the true value of the land thereby occupied.

* * * * *

He shall be bound to maintain in sufficient repair, at his own expense, the bridges and drains required for the passage of the water, whether on the farms or across the roads, so that these latter shall suffer no injury, especially in rainy weather.^a

East of the republic of Milan the still greater republic of Venice was at the same time actively aiding in the development of irrigation. The archives of Venice show that there must have been legis-

^a Italian Irrigation, by R. Baird Smith, Vol. II, pp. 118 and 119.

lation, or at least a well-defined system of administration of public waters, older than any recorded statutes. In the litigation between the Ritorto and Muzza canals there were exhibited grants of water from the Venetian republic, dating back to the twelfth century. There are records of rulings relative to water rights from the Adda River made by the Emperor Frederick in 1183.

A significant feature of this early evolution of irrigation institutions was the organization of irrigators into associations for the building and management of irrigation works. This ability of the Italian landowners to associate themselves together and work in partnership to carry out monumental enterprises is one of the principal reasons for the success which irrigation has attained in the Valley of the Po. Irrigated agriculture must be either cooperative or corporate. In Italy the corporate idea has never attained much prominence. Even in the management of government works the cooperative principle dominates, as the work of the government almost invariably starts with providing and disposing of water by wholesale to cooperative associations. In Lombardy and in the province of Cremona the existence of these cooperative associations antedated formal rules or laws for their government. This was also true of the Veronese territory, where laws for the regulation of water-users' associations were passed as early as 1445. The early water laws of Verona show that the Venetian senate must have given much attention to this subject. As in the laws of the Venetian republic, water was considered a public property, and a right to divert it could be acquired by grant. There was provision for the arbitration of damages and for the prosecution of the work by giving bonds for such damages. The following abstract from the Venetian water laws of 1445 illustrates these principles:

1. Every inhabitant of the territory of Verona is at liberty to derive, from the rivers appertaining to the State, such supply of water as is necessary for the irrigation of his property on obtaining the requisite authority from competent magistrates and under the condition that he inflicts no injury on parties possessing older rights to the same waters.

2. Whoever shall obtain the right of establishing an irrigation channel may demand a passage for the water across the land of any other person, paying, however, to the proprietor twice the value of the land occupied.

3. This value shall be fixed by skillful men chosen by the parties interested.

4. The compensation shall be payable in advance, except when the proprietor of the land is willing to grant a delay thereof.

5. On fulfillment of the above conditions the sale of the land demanded shall be obligatory and should be effected by a legal act.

6. In case of refusal on the part of the proprietor to acquiesce in the preceding terms it shall be competent to the administrative authority (the Podesta) to adopt compulsory measures, since the right to the possession of the land exists, without reference to the inclinations of individuals, corporations, or communities.

7. Possession obtained in execution of the present statute shall be held good and admissible as regards the grantee.

8. In the case of a proprietor refusing all acquiescence in the possession thus granted and declining to receive the price of the land, regulated as above prescribed, this price shall then be deposited with the authorities, and immediately after this formality the works of irrigation may be begun.^a

That the doctrine of public ownership of water, the protection of existing rights to water against encroachment from later users, and the establishment of rights by prescription as well as by grant had their origin in the Roman civil law is shown by the following extracts from the Pandects:

252. (The Emperors Diocletian and Maximian to Julian.) If it can be fully proven that a flow of water through certain places is according to ancient custom, and that according to observation it shows usefulness in irrigating certain tracts of land, our procurator will provide that no innovation against the old form and established custom be permitted. (May, A. D. 286.)

253. (The Emperors Arcadius and Honorius to Asterius, Count of the East.) We ordain that ancient water rights, established by long ownership, should continue to the individual citizen, undisturbed by innovation: Provided, however, that the quantity which each takes by ancient right is that which by custom he has been taking continuously until the present day.

Continuing punishment (life sentence) will be given those who for the irrigation of fields or the beautification of gardens consume the water through furtive channels. (Nov., A. D. 397.)

257. (Pomponius.) From my water right, so Labeo says, I may accommodate any of my neighbors with water. On the other hand, Proculus holds that the water may not be used for any other part of the estate than that for which the right was acquired. The opinion of Proculus is the truer one.

269. (Ulpian.) In the granting of a right for conveying water it is necessary to seek the consent not only of those on whose place the water arises, but also of those to whom the use of the water belongs—that is, of those to whom the servitude of the water is due: and not without cause, for as their right is diminished it is reasonable to inquire whether they consent. And speaking generally, whether a person has a right in the whole estate, or in the spot where the water takes rise, or in the water itself, his wish must be respected.^b

Among other influences which modified the earlier Italian law was the subjection of a portion of the Valley of the Po to the dominion of Spain. The Spanish Kingdom showed great interest in irrigation development, especially in a part of the province of Piedmont, and this could hardly have been exercised without some influence having been felt from the Moorish laws and customs which had brought irrigation to such perfection in southern Spain. A less happy influence resulted from the conquests of northern Italy by the northern Germanic tribes, who brought with them feudal ideas regarding property rights. Streams became under their domination the absolute

^a Italian Irrigation, by R. Baird Smith, Vol. II, p. 122.

^b Roman Water Law, translated from the Pandects of Justinian by Eugene F. Ware, pp. 101–103, 106, 107.

personal property of the ruler and subject to his disposal, either by sale, by grant limited in time or condition, or by absolute perpetual rights. Usually when grants were made to persons they were limited to the life of the person, but when made to an estate they were not extinguished on the death of the owner of the estate.

The mingling of these different influences gave to irrigation in this valley a fragmentary and oftentimes discordant character. This is shown in the multitude of measures employed for land, water, and values, the wide differences in the character of water rights, and in the restrictions placed on users of water. Generally speaking, for the century preceding the establishment of the present code of laws water rights were acquired in three ways:

- (1) Through the sale of absolute perpetual rights.
- (2) Through the establishment of perpetual licenses to use water on the payment of a fixed annual amount.
- (3) Through the granting of temporary licenses or franchises, either free or for a fixed annual charge, with the rights reverting to the public at the expiration of the license period.

The greater number of the perpetual rights were granted to the noble families and municipal or religious corporations; in other words, those who exercised feudal privileges. The doctrine of personal ownership in water, either on the part of the sovereign or on the part of those acquiring rights from the sovereign, was a most prolific source of abuses throughout the centuries that it was in operation, and the most important reform brought about by the law of 1884 was the prohibition of any further grants of perpetual rights except by a law of the Kingdom. All rights granted through the administrative officials are limited in time, the franchise period being usually thirty years. While the sale or grant of perpetual rights to water to those having money to construct costly works led to a more rapid extension of irrigation than would otherwise have been possible, the power thus conferred resulted in hardships and abuses to farmers who used the water. The selfishness and greed of the owners of these rights led to combinations to maintain excessive charges and to resist the Government in its attempts to exercise a reasonable and moderate supervision, or even to enforce the limitations in the original grant. The whole tendency of modern Italian irrigation law and administration is away from this policy. Only licenses to use water are granted, and for these there has to be compensation. This broad recognition of public ownership of water is generally, if not universally, approved. The complaints are not against the limitations imposed. Public sentiment favors the withholding of any rights whatever where there is a possibility that by keeping public control of the water untrammelled it may be made to serve a higher use in the future.

In this country no charges are made for the water diverted from streams for irrigation or taken for power, and all rights secured are perpetual. In this we are following the reckless, wasteful, and imprudent policy that has governed this country in its management of all its public resources. We are giving away rights to water just as we have given away lands, mines, and franchises in cities. When we consider the vital relation which water supplies have to the social and industrial development of the arid region and the power which this control gives, we can only be impressed with the belief that it would be more prudent to take warning from Italy's experience and follow the course of that Kingdom.

The changes which have taken place within the past ten years ought to give us pause. Within this period the value of running water in the generation of electric power has been augmented to an extent which can not be stated in percentages. The demand of cities and towns for water for domestic and manufacturing purposes is assuming proportions utterly unthought of when our earlier water laws were framed. Similar changes in the importance and value of water uses are likely to continue, and if development can be secured without sacrificing public ownership of this vital element such ownership ought to be retained. The experience of Italy shows that it is not necessary to give perpetual rights to secure the building of irrigation canals or the construction of electric power plants. Nowhere in the world has irrigation and power development made greater strides during the past twenty years than in northern Italy, yet every water right is limited in time and a modest charge made for all the water diverted. It is confidently believed that in this country as substantial and costly irrigation canals, and as comprehensive and effective power plants would be built under thirty-year water-right franchises as are now being built under grants of perpetual rights. A change in our policy to limited franchises would give an opportunity to the next generation of fixing conditions for renewal so as to secure the largest and best use of our water resources. The granting of perpetual rights, on the other hand, is open to the danger of combinations of water-right holders, which will prevent the Western States obtaining the just and fair local benefit from their natural resources because those holding these rights will not limit charges to the cost of the service rendered, but by what a competing service would cost. The growth of cities is already making it necessary to take water now used for irrigation for domestic purposes. Any real loss of property caused by such change in the use of water ought to be paid for, but the danger of perpetual grants is that their holders will add to this a charge for the right surrendered, which rights are now being acquired without cost and without any compensating benefit to the public. Limiting the life of water rights to a definite period of time

is one of the features of Italian water law which the United States should adopt, and the sooner this is done the better for the future welfare of the arid region.

THE WATER LAW OF MODERN ITALY.

The founding of the Kingdom of Italy by the union of the provinces which had hitherto been under separate rule made the National Government the successor to all the rights which had belonged to these separate provinces, and one of the first acts of the Kingdom was the declaration of the public ownership of all unappropriated public waters, these being defined as those having perennial sources. The law excepted in this declaration the rights already acquired, which the Government recognizes regardless of their origin.

At the time of the passage of the law of 1884 there were two chief reasons for such legislation. The first was to systematize and improve the distribution of water among existing works, and the second was to aid and properly control the further diversion and use of water. The manner in which this was accomplished has been clearly summarized in a letter from the Italian minister of agriculture, prepared in 1905, and given as Appendix A.

THE DETERMINATION OF EXISTING RIGHTS.

As the law affects only public waters, the first step in its administration was to locate these waters, and the law made provision for an immediate listing and classification of all public water supplies. Objections to this list when made could be filed within three months, and if they could not be settled by conference with the administrative officials they were referred to the courts. After all questions had been settled the lists were to be officially promulgated by royal decree. The next step after the listing of public waters was the fixing of a list of location, amounts, and character of the existing rights of these waters. This was made the duty of the ministry of public works, which was to compile, publish, and keep in each province a list of all diversions of public waters. In the making up of this list of existing rights each user was required to file a statement of his right to show—

(1) Location of headworks and place of returning unused water to stream.

(2) The use to which the water is put.

(3) The approximate quantity of water used, which may be indicated by the area irrigated or by stating the nature and importance of the works served.

(4) The nature of the title, or, lacking this, the period of possession.

These statements were to be filed within two years from the date of publication of the list of public waters, the penalty for failure being a fine, and after three years the cutting off of the water.

This law does not define public waters, but in the civil code "rivers and torrents" are declared to belong to the public domain, and whether a given water supply comes within this classification is a question of fact to be determined by the courts. In the absence of a definition of public waters the list provided for by law has never been made, although hydrographic surveys of most of the Kingdom have been completed. Since the list of rights to public waters must be based on the list of such waters that list has not been made.

The compilation of the lists of existing diversions involved the official listing not only of the location of these diversions, but the dates of the rights and consequently their priorities and the amounts of water appropriated. This work on many streams was a difficult and laborious performance. It was usually intrusted to special commissions having duties analogous to those of the State boards of water control in Wyoming and Nebraska. In those States the right of appeal to the court exists, but has not often been exercised. In Italy, however, the antiquity of the rights, the wide diversity in the character of the grants, and the fact that these were often established under separate rulers, have made litigation in the settlement of the ancient priorities one of the conspicuous features of Italian irrigation during the past twenty years.

THE ACQUIREMENT OF NEW RIGHTS.

Since the passage of the law of 1884 whoever wishes to divert public water for irrigation, manufacturing, or power purposes must first obtain a permit from the Government. These concessions are granted either by a law of the Kingdom or by an administrative decree and are always made subject to existing rights. As a rule they are limited to thirty years, but perpetual rights may be acquired by a law of the Kingdom.

While the law makes the nation supreme in matters relating to the granting of rights for irrigation, it intrusts the exercise of this authority to local officials in the granting of rights of only local interest, reserving to the National Government those of greater importance. In doing this it was hoped to give local control in local matters and, as stated by the minister of agriculture in a letter written in 1905 (see Appendix A), to decentralize as far as possible the administration of water.

This division of power has not, however, been satisfactory, at least to the officials of the General Government, and a commission was appointed in 1898 to recommend changes in the existing law. The

report of this commission shows that the reason for its appointment was the claim that the provincial officials were not exercising proper care in granting permits, especially rights for the development of power. It was claimed that they were allowing power rights to get into the hands of foreign capitalists who were establishing a monopoly for the exploitation of the *real users of power*. The rapid acquirement of power privileges in the Western States by foreign corporations makes the consideration of the same question of urgent importance in this country.

The proposed cure for this threatened monopoly of natural resources was to give the exclusive authority to grant such rights to the General Government. The principle announced by the commission was that the Government had the unquestioned right to take any water supplies, even those of private owners, for its own use, and therefore it had the right to examine every application for water for power to determine whether the right, if granted, would interfere with a prospective or future use by the Government for its own purposes, especially for the electrical operation of the Government railroads. This commission recommended the creation by law of a permanent Government board, to which all such applications should be referred. No such law has been enacted, but a commission, formed on the lines recommended, has been created by royal decree.

The consideration given by Italy to the division of authority over irrigation between the provinces and the Kingdom is of especial interest to the United States, because as yet it has not been definitely settled in this country how far the several States and how far the nation is to exercise control over public waters, especially the water of interstate streams. The litigation between Kansas and Colorado over the waters of the Arkansas River, now pending in the United States Supreme Court, raises the question as to the need of some paramount authority in the protection of existing rights across State lines. The subject of interstate rights, the exercise of authority by the Federal Government over forest reserves, the management of irrigation works built by the Federal Government, and the growing value of water both for irrigation and industrial uses are each influences which must in time require a further consideration of the relation of the nation and the State to irrigation and a closer definition of the duties and responsibilities of the local and general governments in this matter. The report of the Italian commission appointed to study this question made it apparent that the water resources of that country are one of the great factors in the nation's wealth and development and warranted greater interest and supervision by the Kingdom than it had hitherto received. It is believed

that future evolution in this country will be along the same line. The report of this commission follows:

Report of the commission nominated by the decree of August 16, 1898, by the ministers of public works, of finance, and of agriculture for the study of the future control of concessions of public water in accordance with the new needs of the State and the national industry.

In the spring of 1898 the minister of public works, the inspector-general of railroads, presented to the minister of finance a demand that there should be placed at the free and exclusive disposition of the State, suspending for the time being all disposition to private parties, all branches of rivers or other bodies of public water.

This provision was stated by that office to be indispensable to the carrying out, without considerable loss of time or the following out of a long procedure either by the State directly or on account of the State by the society to which it delegated the operation of the railroads, of experiments to solve the problem of the technical utility and economy of adopting either at one time or gradually by whatever methods may seem to be best, the substitution for steam power of a system of operating railroads by water power by means of electricity generated at considerable distances from the points of use. There was attached to this demand a list made by the minister showing 95 localities in which it was considered necessary to absolutely prohibit concessions of public water to private parties and reserve this water to the needs of the State and to existing power plants, without prejudice to other localities which might be included in this list in the course of time.

The minister of finance, director-general of the public moneys, favored this action, and, in order to advance it as far as possible, indicated to the prefects in the territory included in the 95 localities above referred to, the necessity for the State to take immediate possession of these waters, and suggested that they not only should not accept new applications from private parties for concessions in these specified regions, but should reject any applications which might be then in hand.

The minister of finance did not cease to submit applications to the minister of public works, because of the opposition of the prefects and because of the possibilities of claims for damages by private parties, because of refusals to accept new applications for concessions or because of dropping applications already received. The procedure prescribed by the law of August 10, 1884, and the regulations of November 26, 1893, is rigid and automatic and does not permit of any alteration except to be authorized by an administrative order in the exercise of the sovereignty belonging to the State on account of its ownership of public property. To confirm any possible doubts, all the prefects, in reply to the notice received from the minister, asserted that their jurisdiction was assigned directly by the law and could not be interrupted by a superior jurisdiction, and having in mind also the possible claims of interested private parties before the courts, refused to hold up applications, either those already made or new ones, for concessions at the points included in the list, and they recommended that the superior authority provide in a definite manner for the regular operation of the law.

To overcome these difficulties, which were more in form than in substance, there was called, at the initiative of the minister of public works, a meeting of delegates of the three ministries interested and representatives of the Railway Society of the Mediterranean and the Adriatic.

In the meantime the flood of applications to the prefects continued as during the previous two years, for obtaining under the forms of law of August 10, 1884, the right to use the water for developing power with the object of developing a commerce in power under conditions which would subject the national industry to a monopoly. The minister of agriculture, by a circular of August 22, 1896, and later the minister of finance by a circular of September, 1897, called this danger to the attention of the prefects, recommending to them a more scrupulous observation of the legislative provisions then in force and a rigid interpretation and enforcement of these provisions. These suggestions of the central authority, not being followed in all the provinces with the scrupulousness and uniformity which is necessary, did not remedy the conditions and there was current, not without foundation, considerable alarm that the syndicates, formed principally of foreign capitalists, would soon have control of all the power which could be developed from our rivers and streams. The honorable Afan De Rivera, then minister of public works, thought it best to stop this, and by circular of June 17, prescribed that the provincial officials and the board of civil engineers should investigate in the preliminary examinations necessary for the granting of applications for power, whether this power could not be utilized for electrical traction on the neighboring railroads, in order that these applications might be referred to the minister of public works and that the minister might veto them whether they were within the competence of the sovereign or of the prefects.

This provision was discussed at length in industrial circles because its immediate effect was to hold up and refer to the minister all applications then in hand. While on the one hand it was to be lamented that by a simple circular there was added another link to the already long and complicated procedure prescribed by the law and regulations, on the other hand it brought a flood of suspended applications to the minister for his decision at a time when an intelligent decision could not be made because of a lack of any knowledge regarding the discharge of streams and the topography and because of the short time given for the substitution of hydraulic power for the operation of the railroads.

This double current of doubts regarding the submission of these applications to the minister, which the circular had brought about, was echoed in the first meeting of the ministerial delegates, to whose attention was called the practical effect of this long suspension of applications, an effect which was felt in the claims of the parties interested in actions brought before the fourth section of the council of state, which obliged the minister to defend the constitutionality of his circular.

A change in political conditions brought into office S. E. Lacava in the place of Rivera as minister of finance. The new minister took up these matters and proposed that this commission be transformed into a regular commission for the consideration of these grave questions. This was the occasion of the present study.

In accordance with the decree creating the commission, there were committed to it the following duties:

(a) To establish the rules and limits in accordance with which diversions of the public waters should be allowed for the purpose of electrical traction of railroads and for industrial and agricultural purposes, which are not less important for the national economy.

(b) To make studies as to what regulations should govern the concessions to public waters in order to avoid speculation and monopoly, and to prevent their being devoted to purposes other than those to which they are dedicated.

(c) To make definite proposals for changes which, in accordance with the decisions on the preceding questions, are considered necessary in the laws and regulations now in force.

A simple statement of these questions is sufficient to show that they are of the greatest importance, especially in regard to our national economy.

After the researches and studies continued during several years by scientists, both alone and associated, in mineralogical engineering, and by our royal mining engineers, it is not now possible to discuss all of the conclusions to which we have come, but we can discuss the scarcity in Italy of coal of the first quality, which has by everyone been considered an indispensable element in all our production, agricultural and industrial. It is true that in recent years there have been discovered several deposits of lignite, each of which is of some importance, but the heating power of this second-grade coal is inferior to that purchased from England and Belgium, and further, the fields now known are limited so that this does not furnish any assurance that the domestic fuel supply will replace, either in whole or in any considerable part, that purchased from abroad, or that it will suffice for local factories or for the movement of agricultural implements. From statistical studies made in recent times and from the periodical reports of the minister of agriculture, it is seen that the commerce in domestic lignite has reached several thousand tons annually, but this is a very small contribution to the needs of our industry, and it continues to use the English and Belgian coals to an extent very little less than that of the years previous to the discovery of the domestic lignite.

Such is the burden that a national industry must support on account of this purchase of fuel, a burden which rests more heavily because of our monetary conditions, and because of variable but always high cost of exchange, which is demonstrated in an approximate way in the following table, compiled and published by the commission on revenue for the ten years, 1888 to 1897, which is accompanied by a calculation of the part of this payment which is to be met by our industrial establishments on account of the necessity of payments being made in gold.

[This table, which is omitted, shows that the average annual value of the coal purchased by the coal importers of Italy for the ten years, 1888 to 1897, is \$20,000,000, of which \$9,000,000 is in excess of the normal price on account of the differences in exchange.]

To the poverty of our geological strata may be contrasted the relative richness of the water supply of Italy.

The snows of the Alps and the eternal glaciers of the high Alpines feed numerous rivers with heavy slope and interminable torrents rich in water for irrigation and in natural falls which are veritable reservoirs of power. This wealth we have in common with Switzerland as we have in common with that country a deficiency of fuel. We have not, up to this time, made a list of our streams and basins of public water and of their productivity. Articles 25 and 26 of the laws of August 10, 1884, prescribed a time for the compilation of such list of public waters and also of a list of its users. Up to the present time neither of these lists has been compiled, and it is not possible to predict the time when they will be finished, because the law did not establish either the technical or the legal criteria for this compilation, nor did the central authority prescribe uniform regulations to local officials, so that it is practically impossible to make these lists. The minister of agriculture, recognizing the urgent necessity of

supplying this want, set his hand to the compilation of hydrographic charts of the Kingdom and to the publication of monographs. The hydrographic charts are published and many monographs have already seen the light.

Having finished the works describing the various parts of Italy, there was begun, through the influence of Zoppi, the measurement and description of our great rivers, but the truly accurate and scientific work such as this last was checked by the death of this noted man, and it is not possible, from what has already been published, to secure the various elements which are necessary to forming a correct idea of the possibilities of power development.

However, the minister of finance directed, in 1894, that the boards of civil engineers of the different provinces should make lists showing the possible power development, and an approximate valuation of this is contained in the following table.

[Table omitted.]

This table shows, for the provinces included, 24,486 available falls, with the possibility of developing an average of 2,642,040 horsepower. This does not include a number of provinces nor the most of the mountain streams. There is also omitted, because of inability to calculate it, the numerous possible power developments which could be artificially made by utilizing the slope of the water course and the creation of drops by new channels. It has been recently estimated that 5,000,000 horsepower might be developed in this way.

In 1901 the minister of agriculture prepared for publication a list of the power developments already in existence.

This table shows a total development of 100,822 horsepower by water power and 412,861 horsepower by steam.

After a long discussion of the operation of the existing law, of proposed changes, and of various legal theories as to the relation of the Government to the public waters the commission concluded, as follows:

The State exercises its *jus imperii* (right of sovereignty) over the public waters as over other property of the public domain. Although in this doctrine the principle prevails that such right is a special phase of property limited by the public interest, on the one hand it is admitted that the State has the full power to use said water directly, to the exclusion of private parties, for the public service organized in the form of an industry; yet, on the other hand, it is advisable that the appropriation should be controlled by a procedure sanctioned by a special law. It is therefore excluded that such appropriation should be made capriciously or with danger of a useless waste of public property, but there should always be a comparison of the public needs with those of private industry, to determine whether the first should have preference over the second, or vice versa. Since this would exclude the system of withdrawing by right of sovereignty certain streams and bodies of public water from concessions to private parties, the commission decided to recommend a permanent system for the examination of private demands with reference to the public needs, or with reference to those needs as embodied in special projects, and also the creation of a permanent and inexpensive body of men expert in matters of this kind, to examine applications and plans, and furnish, case by case, to the minister of public works, the information necessary for his decision.

Regarding concessions for hydro-electric power for private industries the commission proposes, for the double purpose of conserving the power in our

streams and bodies of public water and of checking its acquirement for speculation to the injury of the real users, the following provisions to be inserted in the law :

1. To prescribe that the society or association for the exercise of a concession may be organized only within the term of six months from the day in which the concession becomes effective. To prohibit any form of cession or subletting of diversions to others before the concession has been utilized, except that concessions to municipalities for public purposes may be sublet provided they are not made objects of speculation.

2. To guarantee the renewal of a thirty-year concession for only one additional thirty-year period, giving the State the right to make renewals for successive periods.

3. To prohibit absolutely any extension of the term established by the contract for utilizing the concession, except in cases where acts of "higher power" justify it. To maintain the periods for the gradual use of the water or power granted in the concession doing away with the corresponding graduation in the payments, and exacting the payment of the whole rental during the term of the agreement, regardless of the use of the water or the power there contemplated.

4. To authorize the State or its grantees to suspend existing uses of water which present obstacles to their projects, and which they do not wish to expropriate, with the obligation to guarantee to these smaller users the delivery of water or power in a quantity equivalent to that suspended, but by a method which makes possible both the old and the new use, with great benefit to the public wealth and without expenses to the one whose use was suspended.

ADMINISTRATION OF THE ITALIAN LAW.

APPLICATIONS FOR PERMITS TO DIVERT WATER.

Permits for diversions from lakes, boundary streams, navigable streams, and streams whose banks are dyked and maintained by the National Government are granted by royal decree, while permits for diversions from all other public water supplies are granted by the prefects of the provinces where the diversions are to be made, except that when opposition is made by interested parties in another province the matter goes to the representatives of the National Government.

THE GRANTING OF CONCESSIONS.

An application must be accompanied by the plans of the works to be built for diverting water and for carrying it to the place of use. These are then submitted to representatives of the provinces interested for their consideration, and are published in the communities interested, after which they are referred to the civil engineering board, which makes an examination of the plans and the places where it is proposed to build the works. The plans are also put on exhibition in each of the communes interested, when all interested parties are allowed to make any objections they may have. Objections may also be made to the works being declared public works, giving them

the right of eminent domain. The board of civil engineers reports the matter back to the provincial deputation, paying special attention to the advisability of granting the concession and the feasibility of the proposed works, having special regard to the public interests, to previous concessions, and in general to the rights of others, and recommends such changes as are deemed necessary to avoid damages to public or private rights. The board also makes recommendations as to the quantity of water to be granted, the nature of the works to be built, the rental to be charged, etc.

Having this report, the provincial deputation acts on the application and transmits it with all the reports and objections and its own recommendations to the prefect to whom application was originally made, and he, after verifying the regularity of the procedure, if it requires the approval of the government officials, transmits it to the ministry of agriculture, industry, and commerce. The minister of agriculture, industry, and commerce transmits it to the minister of public works with his recommendations. Then it is referred to the superior council for public works, which examines the plans and reports on the hydraulic features and also as to its effect on existing rights. The application then goes to the ministry of finance for examination as to provisions for rental to be paid, and may be returned to the prefect from whom it started for correction. When it is finally in shape, the minister of finance draws up the royal decree of concession. This decree shows:

- (a) The name, given name, and paternity of the grantee.
- (b) The source of the water and the location of the diversion works or the power plant, which is to be established.
- (c) The use to which the water diverted is to be put, or the nature of the power plant.
- (d) The duration of the concession.
- (e) The annual rental to be paid, unless under Art. 15 of the law the concession is free (to charitable institutions).
- (f) The quantity of water granted, the power to be developed, and the area to be irrigated or reclaimed.
- (g) The conditions and obligations under which the concession is to be exercised.

The decree is recorded by the prefect and published in all the provinces interested, and copies are sent to the intendant of finance and the board of civil engineers.

The expense for the publication and the examination of an application is paid by the applicant, and when it is considered necessary the prefect may require the deposit of the estimated amount of this expense.

No further procedure is prescribed by the law of August 10, 1884, which governs these matters, but in 1899 there was created by royal

decree what is known as the permanent central commission for the consideration of applications for the diversion of public waters (see p. 72). This commission is composed as follows:

(a) The president of the hydraulic section of the superior council of public works, who shall be president.

(b) Two members of the superior council of public works.

(c) One member of the superior committee on railroads.

(d) One royal chief technical inspector of railroads.

(e) One deputy attorney-general to be named by the attorney-general.

(f) One manufacturer to be nominated by the minister of agriculture, industry, and commerce.

(g) One representative of each of the ministries of public works and of finance and one representative of the ministry of agriculture, industry, and commerce, to be named by the respective ministers from those whose position is not below the grade of a chief of division.

(h) One representative of each of the two ministries of war and marine, having rank not less than lieutenant-colonel, whenever the applications being considered either directly or indirectly affect the interests of these administrations.

(i) The chief of the transportation office, when the application for the diversion of water affects the railroad service.

Two officials, one technical and the other administrative, with a grade of chief of section, who shall perform the duties of the secretary.

The duties of this commission are purely advisory, as shown by the ministerial decree prescribing the rules by which it shall be governed, which provide—

That applications for the diversion of the public water, upon which the minister of public works shall consider it advisable to ask the opinion of the permanent central commission * * * shall be communicated by that minister to the president of the commission with all the documents relating thereto, and with a statement of the special points upon which the opinion of the commission is desired.

This commission is to take into consideration especially the public interests, determining in each instance whether the granting of the application under consideration will interfere with the eventual electrical operation of the Government railroads.

The minutes of this commission, as published in its annual report, give communications from the minister of public works and the action taken on the applications submitted to it by the commission. These communications from the minister in every case give a summary statement of the conditions and ask for the opinion of the commission on particular points rather than on the whole question of the granting or refusal of the application. The action of the commission

in every case takes the form of a motion, stating the opinion of the commission on these points, the commission having decided that it had no right to express its opinion on any other subjects.

Those diverting water from public streams are required to put in sufficient headworks to control the diversions of water, and are required to regulate these works in such a way as not to injure the rights of others. They must build such works as are required by the administrative authorities, and the public authorities are given authority to see that the conditions of the concession are carried out.

LIMITATIONS ON PERMITS OR CONCESSIONS.

The Kingdom of Italy charges for the public waters diverted exactly as the Government of the United States charges for timber cut from the forest reserves or the public domain. The Government charges for water taken from streams are fixed by law, and are as follows:

Rates for water drawn from public streams on concessions from Italian Government.

	Italian.	United States equivalent.
Water for drinking or irrigation, without the obligation of returning the waste water.	100 liters per second, 50 lire per year.	\$2.83 per cubic foot per second.
Same quantity, with the obligation to return waste water.	25 lire per year	\$1.42 per cubic foot per second.
For the irrigation of lands with water which it is impracticable to measure.	5 lire per hectare per year..	40 cents per acre.
For mixed use for irrigation and reclamation.	25 lire per 100 liters per second.	\$1.42 per cubic foot per second.
For each nominal horsepower, computed on the difference in elevation of the water above and below the wheels.	3 lire per year	60 cents per nominal horsepower.
For floating mills	1 lire per horsepower.....	20 cents per horsepower.
Mills operated intermittently on account of scarcity of water.	1 lire per nominal horsepower averaged for the year.	20 cents per average horsepower.

The permits to divert water fix with precision the manner of diversion and the use to be made of the water. If there is an obligation to return the waste water, the rental charge is less than where there is no such obligation. The quantity of water to be taken is fixed, together with the size and location of all main canals and the use to be made of the water. A grantee of water for irrigation may use the water for power if others are not injured by this use, but those having a grant of water for power may not use it for irrigation except through the issuance of a special permit. In each case where a double use is allowed the higher rate of the two is charged.

Permits to divert water for irrigation are usually for fixed volumes, the grantee having the right to use the water on any areas under the canal or to sublet the water for any prices which can be

secured; but where the water granted for irrigation can not be measured, the rental is based on the area irrigated, which is then designated.

GOVERNMENT CANALS.

In addition to owning the water of the streams the Government of Italy owns certain canals. Some of these canals the Government operates, leasing the water to associations and individuals in much the same way as it leases water directly from the streams; in some cases it leases entire canals.

Under canals operated permanently by the Government leases are usually limited to periods of six years, although leases for single seasons are made. Leases including an entire canal have a maximum period of thirty years.

Government canals are controlled by the minister of finance and his subordinates. This control includes the operation of the canals as well as their management. The classification of canal officials and their salaries are fixed by law, but their duties and places are assigned by officials of the treasury. These treasury officials inspect the canals and determine what repairs are necessary and attend to the distribution of water. The work of maintenance and repairs is usually done under contract, the estimates being made by the treasury officials and the contracts let by competitive bidding.

Canals permanently leased are inspected by the Government officials, but repairs and maintenance must be done by the lessee.

Canals sometimes leased and sometimes operated by the Government are maintained by the Government or the lessee, according to the forms of contracts entered into, but the amount and nature of work to be done is determined by the Government officials.

The existence of ancient rights where water is either furnished free or where only a nominal rental is charged interferes with the profitable operation of many Government systems and makes the sub-leasing of water by the holders of these ancient rights a conspicuous feature in the irrigation from Government canals.

GOVERNMENT AID TO IRRIGATION.

The conditions controlling Government aid are set forth in the letter of the minister of agriculture, given in Appendix A. They are in brief that the works must have a certain size, 35½ cubic feet per second being the minimum; that the community or province where the works are situated must contribute not less than one-tenth the sum granted by the Government, and this contribution must be made without interest or repayment. The aid given by the Kingdom is, in effect, a part payment of the interest on money borrowed to

carry out the work. The total contribution is usually 3 per cent of the estimated cost of the work for the first ten years, 2 per cent a year for a second period of ten years, and 1 per cent a year for the third ten-year period. Such aid may be given to enlarge or complete works as well as for new ones.

Parties wishing to obtain Government aid apply to the minister of agriculture, industry, and commerce. The application must be accompanied by plans of the works to be built, a certified copy of the transactions of the association, commune, or province asking for the grant, evidence of a permit to divert the water or of ownership of a water supply, a statement of the resources and methods for building works, a statement of the quantity of water which is to be used for irrigation or for other purposes, and a statement of the acts pledging local provinces or communes to contribute not less than one-tenth of the sum given by the State. These applications are considered first by the minister of agriculture, industry, and commerce and by the minister of public works, and if approved the grant is made by ministerial decree.

The policy of the Government is to let local authorities take the initiative in preparing the plans for the construction of works asking Government aid and to assume the responsibility for carrying out those works. The Government, as a condition of extending aid, has the right to amend plans and to supervise the carrying out of the work, although in many instances this supervision is simply nominal.

The Government further aids irrigation by the granting of loans from State banks. The operation through the minister of finance of State banks throughout the Kingdom is a part of the financial system of Italy. These banks perform many commercial functions resembling those of trust companies in the United States, but in addition they are the official depositories of the Government and perform many of the financial operations of the Government, like the making of loans to approved irrigation projects. The procedure for making these loans, the amount of interest to be charged, and the security to be demanded are all fixed by the minister of finance. The maximum period of loans is ten years, except where sinking funds are provided, when a maximum period of twenty-five years is allowed.

ASSOCIATIONS FOR IRRIGATION.

Most of the actual use of water in Italy is controlled by associations of irrigators. Some of these associations, such as the Association for the Increase of Irrigation in the Cremona Territory and the association west of the Sesia, control whole systems of canals, while other associations are formed to operate single laterals. These are formed

under the general incorporation laws and under special laws providing for such associations. The civil code provides for two classes of associations, voluntary and obligatory. The first is composed entirely of those who wish to join. The obligatory associations are organized by the courts upon the application of a majority of those interested when the "exercise, the conservation, and the defense" of the common rights, can not be divided without danger. Special laws provide that the articles of incorporation must show the extent and boundaries of the lands to be irrigated, the means by which irrigation is to be accomplished, the conditions for admission to membership, the mode of administration, and the powers assigned to the administration of the association. The administration has the right to represent the association in the courts, in making contracts, and in all other matters in which the association is interested within the limits of the powers fixed by the articles of incorporation. An association covering more than 50 acres may be given the right to levy and collect taxes for association purposes, this right to be granted by royal decree. Application for such a decree is made to the prefect of the province and by him transmitted to the minister of agriculture, industry, and commerce, who proposes the royal decree granting the right.

Increase of land values due to irrigation provided by associations organized under these laws is not taxable for a period of thirty years, provided the government has not contributed to the construction of the works; otherwise the increase is taxable.

Lands included within the association are subject to right of way for diversion works, irrigation canals, and drainage canals, the payments to be made for the lands taken for right of way to be determined by a board of arbitration.

With the preceding explanation and that of the minister of agriculture, which follows, it is believed that the methods of its operation and the points of resemblance and differences between it and that of the irrigation codes of the Western States can be easily understood.

APPENDIX A.—LETTER FROM MINISTER OF AGRICULTURE.

LEGISLATION UPON WATER TO BE USED FOR IRRIGATION.

The civil code in articles 543, 544, and 545 established that waters which are not public—that is, which are private, which run naturally and without controlling works, and which are not subject to the rights of others—may, while passing, be used for irrigation by the owners of the lands which border the water course, or which are traversed by the stream, on condition of returning what is left to the stream. The obligation to restore water not used arises from the rights which the proprietors of lower land have to the use of the water which remains in order that it may not be lost, but may serve for agricultural as well as industrial purposes. To conciliate the opposing interest of the various proprietors by whom the water can be used there is established a tribunal charged with hearing agricultural cases and with facilitating the use of private waters for agricultural purposes.

There is provision for irrigation, either by direct diversions from the public water courses or by irrigation canals belonging to the ancient states or by Government irrigation canals.

The concessions for diversions from the public water courses are regulated by the law of August 10, 1884, No. 2644, and the regulations of November 26, 1893, No. 710. The scope of these laws, which add nothing new to the fundamental principles of public waters, are as follows:

(a) To facilitate the administrative procedures for authorizing new hydraulic work to be executed by private parties for agricultural or industrial purposes.

(b) To facilitate new concessions of public waters, especially as regards industrial uses.

(c) To decentralize from the central administration to the prefects all functions of secondary importance.

(d) Recognize existing rights.

(e) To create an official register of all the public waters of the different provinces of the Kingdom.

(f) To provide for the creation of a list of all existing concessions for the diversion of public waters.

The fundamental principles upon which these are based are as follows:

(a) To preserve free navigation of navigable streams.

(b) To have special regard for the lakes and boundary streams and those rivers whose banks place them in the second category and which are therefore maintained at public expense, except on agreement of those interested.

(c) Not to make perpetual concessions except by law.

(d) To require, for diversions with open gates, the construction and maintenance of works recognized to be sufficient to guarantee the public and private safety.

The price of water for the irrigation of lands is established by article 14 of the law at 50 lire for each module (100 liters per second), except when percolating or waste water is not returned, and at the rate of 25 lire when these are restored.

For lands for which irrigation can not be had through a taxed gate the users pay an annual tax of 0.5 lire for each hectare (2.5 acres).

To render more possible the improvement of lands, article 16 of the law provides that in concessions for the diversions of water for the optional use for irrigation or reclamation, the charge is reduced to one-half of that established for irrigation without returning the seepage or waste water, and for reclamation alone the charge is reduced to one-fifth.

The rights to divert public waters are granted, according to the law of August 10, 1884, No. 2644, by royal decree, proposed by the minister of finance or the prefect of the province in which the diversion is to be made, according as the water is to be taken from a lake, a boundary stream, or a navigable river whose banks place it among works of the second class, or from some other public water course.

When an application for a concession is such that it requires a royal decree, the documents are transmitted by the local prefecture to the ministry of public works and by it to the ministry of agriculture for a preliminary examination, to determine the public interest in the matter and whether it conforms to the regulations. If it is not in conflict with the regulations, the prefect collects all the documents in the case and transmits them to the ministry of agriculture, which prepares its own recommendations as to the approval or rejection of the application. After this the application is examined by the ministry of public works and the ministry of finance, and this ministry, if it approves the proposed diversion, promotes the royal decree of concession. In cases in which a royal decree is not required the same procedure is followed except that the application is not examined by the central administrations.

The distribution of the water belonging to the canals of the ancient states for irrigation, the watering of stock, or for other agricultural uses is governed by the regulations of March 1, 1896, No. 83.

The concessions for these aqueducts are made—

1. For a season or for a series of seasons or for a year.
2. For a taxed gate or for a free gate measured according to the area irrigated, a wheel or an opening, according to the local regulations in each province or for each aqueduct or in accordance with local customs.

The canals of the ancient states, which have a total length of 840 kilometers (522 miles), with an average discharge of 87,000 liters (3,060 cubic feet) per second, have these rights on account of perpetual use existing from antiquity, so that they limit the quantity of water which can be controlled for irrigation by the national administration.

Of much greater importance from an agricultural standpoint are the government irrigation canals (Cavour Canal and connections), which are distributed through the provinces of Torino, Novara, Pavia, and Alessandria. These, in fact, with their branches, distributaries, and secondary ditches, have a length of over 1,400 kilometers (870 miles).

The operation of these canals is governed by the regulations of August 27, 1890 (No. 6861), and the disposal of water from them for agricultural and industrial uses is governed by the tariff approved by ministerial decree of January 5, 1905.

The nominal price for a continuous flow for irrigation, drawn through a taxed gate, is at the rate of 2,300 lire per module (\$163 per cubic foot per second) for the summer season and 180 lire per module during the winter season.

There is also provision, under special conditions, for the disposal of water through free gates at the following prices :

Rice, per hectare -----	lire__100=	\$8. 00 per acre.
Meadows and marcite, per hectare-----	do___ 60=	4. 80 per acre.
Corn and March-sown crops, per hectare, each watering -----	lire__ 15=	1. 20 per acre.

A reduction of 20 per cent of the normal price is given on water which is to serve for the first irrigation and for the two years following for summer irrigation of lands not before irrigated.

The concessions are granted by the administration of the Government canals in Torino by issuing licenses, and the price of the water is paid in one payment on December 31 of the year in which the water has been received. The rates are collected by the collector of direct taxes in accordance with the law governing the collection of taxes dated June 29, 1902, No. 231.

The first traces of laws regarding associations for irrigation are found in the separate municipal statutes. Although the greater part of these statutes has come to light in the kingdom of Milan and the republic of Venice, yet there is evidence that these associations were in existence before. The greater part of the rules contained in these statutes were in existence long before the date of their promulgation. There are indications of such associations for irrigation in the statutes of all the cities of Lombardy, and especially in those of the city of Crema. The purpose of all these associations was to regulate the use of water, which was sanctioned by the statutes of Lombardy and was introduced in 1445 into the Veronese territory.

But to come to the legislation which at present controls this important matter associations for irrigation, whether optional or obligatory, are regulated by the provisions of articles 657 to 661 of the civil code.

Article 657 provides that those who have a common interest in the diversion and use of water, either for improvement (*bonifica*) or for the drying of lands may join in an association for the purpose of exercising, conserving, and defending their rights. Article 659 provides these associations may be formed by the ordinary courts upon application of a majority of those interested, giving notice to the others, whenever the exercise, conservation, and defense of their common rights can not be divided without grave danger. Article 660 provides that such an association shall not be dissolved except upon the vote of three-fourths of those interested, or when it is possible to make the division without injury, to be determined upon the application of any one of those interested.

These provisions are not applicable to associations for artificial drains, the control of which in the public interest is governed by section 4, title 3, of the law on public works of March 20, 1865, No. 2248, Appendix F.

The special laws which govern these matters are those of May 29, 1873, No. 1387; of December 25, 1883, No. 1790, and of February 28, 1886, No. 3731, which were harmonized by royal decree of February 28, 1886, No. 3732, accompanied by the necessary regulations approved by royal decree of the same date, No. 3733, article 18 of which was modified by the royal decree of January 30, 1890, No. 6648, and all the preceding provisions, in so far as they relate to the present organization of irrigation associations, were superseded by the law of May 11, 1890.

There should be included with these laws those facilitating the operation of associations of the owners of farm lands and those aiding the province and communes in the construction of new reservoirs, new diversion works, and works for the transporting of the water to the place of irrigation, and those

providing for financial aid by the State by facilitating the securing of loans from the Bank of Deposit and Loan, and by granting the power to collect money from the members of the association, according to the procedure prescribed for the collection of direct taxes.

The members of the association contribute to the expense of the association by means of a tax on all the lands included, in a proportion established by agreement and by the proper commune.

The collections from the members of the association are made by the administration of the association according to the forms and with the privileges and powers in force for the collection of the direct taxes, and this for those associations which show that the area to be irrigated is not less than 20 hectares (50 acres). The lands included within the boundaries to be irrigated and also the lands adjoining the boundaries are subjected to whatever servitude is necessary for right of way for works for the diversion, transportation, and wasting of water.

The Bank of Deposit and Loan may grant to associations for irrigation legally organized, to a province, or commune, for the construction of new reservoirs or new works for the diversion of water and for conveying it to the place of use, loans to be repaid with the normal rate of interest.

The ministry of agriculture, industry, and commerce may grant aid to an association for irrigation, a commune, or a province for the above-mentioned purposes. And with the consent of the council of State similar aid may be given to private parties.

Such aid may be given by the State only when the water is to be actually used for irrigation, and on the following conditions:

1. That water is to be secured in a quantity not less than 1 module (100 liters per second, 35.1 sec.-ft.), except that under special conditions of culture aid may be given for smaller quantities of water, but not less than one-fourth module.

2. That the communes and provinces in which the territory to be irrigated is situated each contribute to the work one-tenth as much as is contributed by the State; and aid will not be granted unless these, either singly or together, apply for the contribution of the State for the construction of irrigation works.

The contribution is granted for a period of not more than thirty years. This period is divided into three equal parts. During the first the contribution shall not be greater than 3 per cent interest on each 100 liras of the expense necessary for the construction of works of the first class (those diverting more than 30 modules of water) and 2 per cent of those of the second class (those diverting less than 30 modules of water). This contribution shall be diminished in the second period by one-third of the above amount, and in the last period by another one-third. In any case the contribution of the State shall not exceed one-half of the interest, exclusive of payments to the sinking fund. This does not apply to a direct tax of 10 liras for registering—where this is not less by law—the document relating to the organization and operation of the association and any other documents during the term of six years which relate to the organization and operations for the building of irrigation works, nor those documents relating to the acquisition of water for irrigation.

The increase in the value of lands on account of irrigation is not subject to the land tax for a period of thirty years.

V. STRINGHER,

Librarian of the Ministry of Agriculture, Industry, and Finance.

ROME, April, 1905.

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